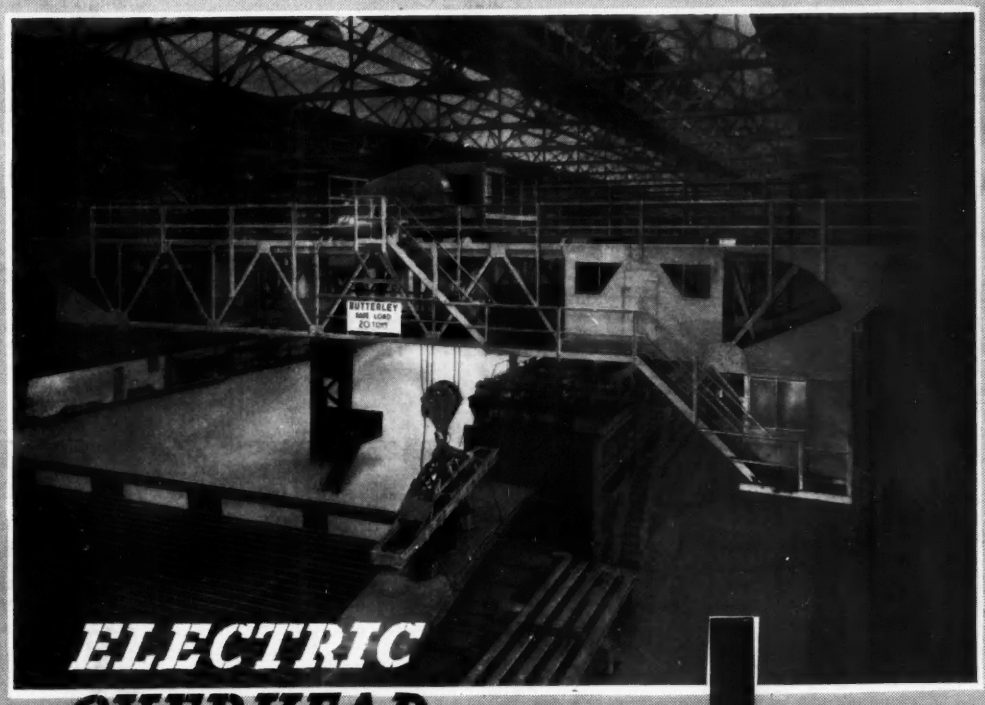
The Engineer

OCTOBER 23, 1953 28, ESSEX ST., STRAND, LONDON, W.C.2 TWO SHILLINGS

UNIVERSITY OF MICHIGAN
NOV 9 1953
ENGINEERING LIBRARY



Appleby-Frodingham Steelworks. New Normalising Plant.

ELECTRIC OVERHEAD TRAVELLING CRANES

by BUTTERLEY

Cranes for heavy duty, of rugged construction for steel mill service. Efficient and reliable, smooth and quiet running.

FOUNDED 1790

THE BUTTERLEY COMPANY LIMITED · RIPLEY · DERBY · ENGLAND

LONDON OFFICE: 20, ASHLEY PLACE, VICTORIA, S.W.1.

E.C.26

...FOR PLANT & MACHINERY OF ALL TYPES:

POWER PLANT *including:*—Turbo Alternators, Steam and Diesel Engine Driven Generating Sets, Air Compressors, Pressure Vessels, Steam Engines, Diesel Engines, Pumps, Fans, AC and DC Electric Motors, Starting Equipment, Transformers, Switchgear, Motor Generating Sets including Anodisers, Welders, Rectifiers, Frequency Changers.

PROCESS PLANT *including:*—Mixers, Blenders, Filter Presses, Hydro Extractors, Crushers, Disintegrators, Driers, Ball Mills, Tube Mills, Jacketed Pans, Glass lined, Rubber lined and Stainless steel equipment, Vacuum and Refrigeration Plant, Distillation equipment, Paint Machinery, etc.

PLASTICS MACHINERY *including:*—Two-roll Mixing Mills, Pre-form Tabletting Machines, Hydraulic Compression and Injection Moulding Presses, Pumps and Accumulators, Extruders, Vulcanising Pans.

MACHINE TOOLS *including:*—Centre Lathes, Capstan and Turret Lathes, Millers, Shapers, Slotters, Grinders, Borers, Planers, Drills, etc.

CONTRACTORS' PLANT *including:*—Tractors, Compressors, Dumpers, Excavators, Grabs, Hoists, Paint Sprayers, Mobile Cranes, Electric Hammers, Locomotives, Concrete Mixers, Concrete Pumps, Roller Pan Mills, Sawbenches, Overhead Travelling Cranes, Pumps, Rollers, Locomotive Steam Cranes, Portal Cranes, Derrick Cranes, Loading Shovels, Weighing Machines, Scaffolding, Winches, Weighbatchers.

BOILERS OF ALL SIZES *including:*—Cochran, Economic, Lancashire, Vertical Cross Tube, Vertical Multi-tubular, Babcock and Wilcox Watertube.

SHEET METAL MACHINERY *including:*—Power Presses, Guillotines, Plate Bending Rolls, Press Brakes, Slitters, etc.

STEEL OF ANY DESCRIPTION *including:*—Steel-framed buildings, Tanks of all sizes, Rails, Railway Track and Accessories, Sections, Structural Steelwork, Pipes and Fittings.

WOOD LANE, LONDON, W.12
'Phone: Shepherds Bush 2070 'Grams: Omniplant, Telex, London
STANNINGLEY, NEAR LEEDS
'Phone: Pudsey 2241 'Grams: Coborn, Leeds
SUNBEAM ROAD, LONDON, N.W.10
'Phone: Elgar 7222/7 'Grams: Omnitools, Harles, London

THE 600 GROUP OF COMPANIES

GEORGE COHEN
SONS AND COMPANY LIMITED
Established 1834

And at Kingsbury (Nr. Tamworth) · Manchester · Glasgow · Morriston, Swansea · Newcastle · Belfast · Sheffield · Southampton · Bath

E/521/G21

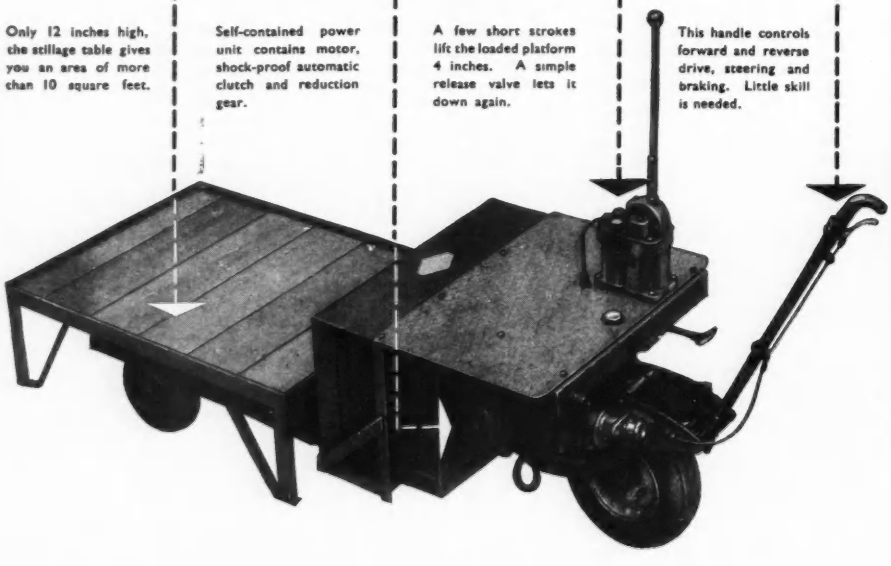
FOUR POINTS TO EFFICIENCY
— and economy too

Only 12 inches high, the stillage table gives you an area of more than 10 square feet.

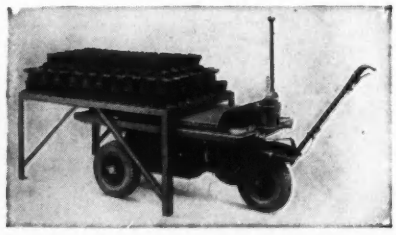
Self-contained power unit contains motor, shock-proof automatic clutch and reduction gear.

A few short strokes lift the loaded platform 4 inches. A simple release valve lets it down again.

This handle controls forward and reverse drive, steering and braking. Little skill is needed.



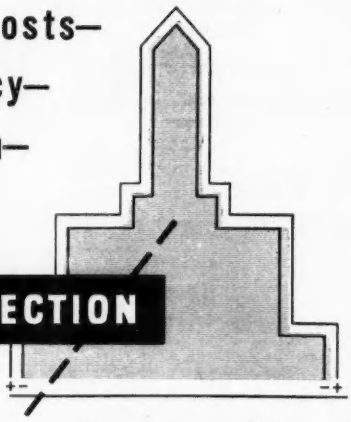
GRAISELEY stillage trucks will carry 20 cwts. at a time, work all day up inclines, round corners and in and out of confined spaces. After 8 or 10 miles they need re-charging with about 4 units of electricity. That's economy for you. At night they simply plug into the charger which automatically switches off when they are ready for the next day's work. Delivery is good at present. May we arrange a demonstration with your nearest service depot ?



For those who prefer a high stillage. This table has an area of 13 square feet and stands 27 inches high.

DIAMOND MOTORS (WOLVERHAMPTON) LTD. Upper Villiers Street, Wolverhampton. Telephone: Wolverhampton 216

t inspection costs—
crease accuracy—
eed production—
with



PROFILE PROJECTION

Inspection technique is revolutionised by the Newton Profile Projector which enables small machined parts to be checked to fine limits in a fraction of the time taken by other methods and with much greater accuracy.

OPERATION
An intense beam is directed on the component so that the silhouette is projected by means of a reflector to the screen. By easily interchanged lenses, the image can be made 10, 15, 25, 50 or 100 times actual size. An image of the component is compared with the master drawing and errors as small as .001in. detected at once. The only requirements are simple workholding jigs and cheap drawings.

Use of the Newton Profile Projector means—

Longer runs on automatic machines, because a tool may be accurately set to cut to the minimum limit. Subsequent wear can continue without interrupting production until the maximum size limit of the component is reached.

Less Scrap because control over accuracy of limits is far more easily exerted. Delicate components can be checked without fear of damage.

Greater Precision—exact magnitude and direction of error is indicated. Standard gauges merely show whether parts are within specified tolerances; they do not show roughness, bad tapering, etc., easily seen by profile projection.

Easy Assembly because individual components making up an assembly, can readily be kept within acceptable limits. Regular quick scrutiny of all drawing dimensions avoids assembly troubles.

No Conventional Gauges—Ordinary shop gauges can be eliminated and arguments about sense of touch regarding 'go' or 'not go' avoided.

Simple Operation with efficiency and speed, by unskilled personnel. Faulty gauging or mishandling of gauges eliminated.

WRITE OR 'PHONE NOW *for descriptive booklet No. NPP/1. Profile projection pays! It can increase production and save time in YOUR works.*

Newton

Distributed by
METROPOLITAN-VICKERS ELECTRICAL CO. LTD., TRAFFORD PARK, M/C 17
Member of the AEI group of companies

N/A301

THE ENGINEER

ESTABLISHED 1856

Vol. 196 No. 5100

OCTOBER 23, 1953

28, Essex Street, Strand, London, W.C.2

Telephone : CENtral 6565 Telegrams : Engineer Newspaper, Estrand, London

Published every Friday Registered as a Newspaper

PRINCIPAL CONTENTS

(Complete contents on page 528)

Craftsmanship and Intelligence 528

North of Scotland Hydro-Electric Schemes—No. V: Part II 514

The International Motor Show—No. I 531

Craftsmanship 517
(A. ROEBUCK)

Iron and Steel Institute in Holland—No. II ... 523

The Development of Broadcasting in Great Britain—No. II 524

Two Novel Fendering Systems 519

Planetary Hot Rolling Mill 526

Swiss Railway Signalling and A.T.C. 528

NOTICE TO READERS
All letters intended for insertion in 'The Engineer' or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications. No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.

SUBSCRIPTIONS
U.K. & ABROAD £5. 10. 0. CANADA £5. 5. 0. annually including postage. Every subscriber is entitled to one FREE copy of the BUYERS GUIDE as published —extra copies 5s. each post free.

CLASSIFIED ADVERTISEMENTS
LINEAGE RATE (Under 1 inch):—2s. 6d. per line of 6 words. Minimum 10s.

INCH RATE (1 inch and over):—Rates per insertion per single column inch—1 insertion—30s. 6 insertions—27s. 6d. 13 insertions—26s. 26 insertions—25s.

USE OF BOX NUMBER: The charge is 2s. including the cost of re-addressing replies, which are forwarded immediately on receipt. N.B. There is no Charge for Box Nos. under "Situations Wanted."

WORDING OF ADVERTISEMENTS: Approximately the first 25 letters of each advertisement are set in heavy type. Advertisers are therefore advised to begin their advertisements with the words they want emphasized.

Advertisements received by Mid-day Tuesday will appear in the issue of Friday the same week. Orders must be accompanied by a remittance.

INDEX TO ADVERTISERS—PAGE 135

PUBLIC APPOINTMENTS

NORTHAMPTON POLYTECHNIC
ST. JOHN STREET, LONDON, E.C.1

AERONAUTICAL ENGINEERING

LECTURER

Applications are invited for appointment as LECTURER in subjects of Aeronautical Engineering, to be mainly concerned in the teaching of Aircraft Structures and Design in Honours Degree and Higher National Certificate Courses. Good academic qualifications and industrial experience necessary. Research experience desirable.

Salary £976 by increments of £25 to £1088.

Further particulars and forms of application are obtainable from the Secretary, to whom applications should be submitted by 6th November. E5786

IMPERIAL COLLEGE OF SCIENCE

CHEMICAL ENGINEERING DEPARTMENT

SCIENCE OR ENGINEERING GRADUATES

SCIENCE or ENGINEERING GRADUATES required for research in Chemical Engineering Department on the combustion characteristics of liquid fuels. Maintenance grants of £300 per annum, plus College fees. Results should be suitable for a higher Degree.

Applications (quoting J.R.L.), with full details, to the Registrar, Imperial College, London, S.W.7. E5740

MONMOUTHSHIRE EDUCATION COMMITTEE

THE TECHNICAL COLLEGE OF MONMOUTHSHIRE, CRUMLIN

TEACHER OF ENGINEERING SUBJECTS

TEACHER OF ENGINEERING SUBJECTS (particularly Workshop Technology) required for January next, chiefly for work to the Ordinary National Certificate and Final City and Guilds levels.

Whilst a Degree or equivalent qualification is desirable, sound and varied industrial experience is essential.

Salary in accordance with the Burnham Technical Scale for Assistants, Grade A.

Further information and forms of application obtainable from the undersigned, should be returned not later than the 14th November, 1953.

C. E. GITTINS,
Director of Education.
County Hall,
Newport, Mon. E5804

LONDON TRANSPORT

DRAWING-OFFICE

TEMPORARY TECHNICAL ASSISTANTS

London Transport require TEMPORARY TECHNICAL ASSISTANTS for Drawing-office, Chiswick. Qualifications, speed and accuracy, some drawing-office and practical experience in one or more of following branches and ability to design equipment : steam, hot water and general pipe services ; general mechanical design and mechanisms, sheet metal work and pneumatic equipment ; structures, runways and lifting equipment. Salary rising to £579, with additional payment for certain recognised qualifications ; medical exam.—Applications within 14 days to Staff Officer (F/EV 257), London Transport, 55, Broadway, S.W.1. For acknowledgment enclose addressed envelope. E5780

BOROUGH OF SWINDON

DEPARTMENT OF THE BOROUGH ENGINEER

MECHANICAL AND HEATING ENGINEER

Applications are invited for the position of MECHANICAL AND HEATING ENGINEER in the Department of the Borough Engineer and Water Engineer at a salary in accordance with A.P.T., Grade VI (£670–£735 per annum) of the National Scales.

Candidates must have passed the Final Examination of the Institution of Mechanical Engineers and have had mechanical and electrical engineering experience.

Applications, on forms obtainable from me, must be returned not later than 7th November, 1953.

Housing accommodation is available.

D. MURRAY JOHN,
Town Clerk.
Civic Offices,
Swindon. E5757

BRITISH RAILWAYS

EASTERN REGION

ASSISTANTS

ASSISTANTS required for Railway Civil Engineer's Office in London. Applicants should be fully experienced in surveying and levelling and setting out work ; have theoretical and practical knowledge of general schemes and estimates, structural design, contract documents, &c. Also experience in detailing and designing reinforced concrete. Salary range £600-£700, dependent upon qualifications and experience. Five-day week and canteen facilities. Certain free and reduced rate rail travel after qualifying period.—Apply in writing, giving particulars of age, experience and qualifications, to the Civil Engineer, Eastern Region, King's Cross Station, London, N.1. E5768

PUBLIC APPOINTMENTS

THE BRITISH TRANSPORT COMMISSION
(DOCKS AND INLAND WATERWAYS)

TECHNICAL ASSISTANT AND RESIDENT ENGINEER

The British Transport Commission (Docks and Inland Waterways), 22, Dorset Square, London, N.W.1, invite applications for the following positions :—

(a) TECHNICAL ASSISTANT, office of the Engineer (General Duties), Hull, at a starting salary of £775 per annum. Candidates should be Corporate Members of the Institution of Civil Engineers, have experience in dock and harbour engineering, and be able to develop scheme plans and collate information required for reports, and assist in investigations in connection therewith.

(b) RESIDENT ENGINEER, Hartlepools Docks, at a starting salary of £825 per annum. Candidates should be Corporate Members of the Institution of Civil Engineers. The duties will include the supervision of the construction by contract of a reinforced concrete quay for a deep-water berth in a tidal basin, and candidates should have previous experience in this class of work. The successful candidate will be appointed to the permanent staff and on completion of the work mentioned (approximately 18 months) will be transferred to an established post.

Applications should be sent to the Staff and Establishment Officer at the above address to arrive not later than the 2nd November, 1953. E5799

BRITISH ELECTRICITY AUTHORITY

SOUTH-EAST SCOTLAND DIVISION

SECOND ASSISTANT ENGINEER (MECHANICAL)

Applications are invited for the position of SECOND ASSISTANT ENGINEER (Mechanical), Generation Construction Department, Divisional Headquarters.

Applicants should be experienced in the design and construction of turbo-generators, boilers, coal and ash handling plant, high-pressure steam and water piping and other ancillary work.

Experience in the preparation of specifications, estimates, analysis of tenders, and a knowledge of thermo-dynamics and hydraulics will be a recommendation.

Preference will be given to applicants who hold a Degree in Mechanical Engineering, are Corporate Members of the Institution of Mechanical Engineers or possess equivalent qualifications.

The salary will be within Schedule C, Class AX/BX, Grade 2 (£834–£997 per annum) of the National Joint Board Agreement.

Applications, stating age and experience, by Monday, 9th November, 1953, to the Divisional Controller, British Electricity Authority, South-East Scotland Division, British Electricity House, Portobello, Midlothian.

J. F. FIELD,
Divisional Controller.
British Electricity House,
Portobello,
Midlothian,
17th October, 1953. E5803

MINISTRY OF WORKS

ENGINEERING DRAUGHTSMEN

ENGINEERING DRAUGHTSMEN required in LONDON, at RISLEY (Nr. Warrington), and BEDFORD. Hostel accommodation at Risley, possibly housing at Bedford.

Experience required in one of the following categories :—

MECHANICAL : layout of factory installations, including process plant, steam boilers and steam distribution, pumping, refrigeration and air conditioning.

Development of mechanical plant for a variety of research projects, including rotating machinery, heavy and light mechanisms, servo systems and pressure vessel applications.

HEATING AND/OR VENTILATING : the design of all types of heating and/or ventilating systems and general domestic engineering installations for all classes of buildings.

Salary : London, £396-£628 ; Risley and Bedford, £374-£597, according to age and experience.

Applicants should have British nationality, technical standard of O.N.C. or equivalent, and have apprenticeship or suitable practical experience of at least three years, one in a drawing-office. Promotion and pension prospects.

State age, nationality, details of training, experience, to W.G.10/C.E.2 (B), Ministry of Works, Abell House, John Islip Street, S.W.1. E9907

THE UNITED CAMBRIDGE HOSPITALS

ADDENBROOKE'S HOSPITAL

ASSISTANT ENGINEER

An ASSISTANT ENGINEER is required whose main duties will be at Addenbrooke's Hospital, Cambridge. Salary £450 by £15 to £525 per annum. House available.

The successful applicant will be responsible to the Chief Engineer for the day-to-day maintenance and operation of the engineering services at that hospital, and will be required to assist with the general maintenance works at other hospitals in the group.

Applicants must be practical men with a sound knowledge of all branches of engineering, and will be expected to take up their duties on 4th January, 1954.

Applications, giving details of technical qualifications, experience and age, with names and addresses of two referees, to be sent to the undersigned not later than 21st November, 1953.

J. A. BEARDSALL,
Secretary.
E5827

PUBLIC APPOINTMENTS

HER MAJESTY'S COLONIAL SERVICE

RAILWAY DEPARTMENT

SUPERINTENDENTS AND WORKS MANAGER

The following vacancies exist in the Railway Department, Nigeria :—

DISTRICT SUPERINTENDENT (CDE 110/14/017).

Appointment either pensionable or on contract at fixed salary of £1500 p.a., with addition up to 20 per cent. for contract appointment. An expatriation allowance of £350 p.a. is also payable. Candidates should be between the ages of 45 and 55 years and must have not less than 15 years' experience of railway traffic operating, commercial practice or locomotive running. They must have held positions of substantial responsibility and be capable of controlling a large staff and negotiating with trade unions. Preference will be given to candidates who have been trained as special apprentices on a recognised first-class railway or who possess equivalent technical qualifications, e.g. A.M.Inst.T., A.M.I. Mech.E., &c. They will be required to produce evidence of competency in Railway Rules and Regulations, train signalling, railway law, economics, statistics, &c.

ASSISTANT DISTRICT SUPERINTENDENT (LOCOMOTIVE) (CDE 110/14/010).

Duties include responsibility to the District Superintendent for the direction and efficient maintenance and working of the Locomotive Running Section. Appointment either pensionable or on contract at a fixed salary of £1435 p.a. with addition up to 20 per cent. for contract appointment. An expatriation allowance of £300 p.a. is also payable. Candidates should be not less than 35 years and must possess A.M.I.Mech.E. or similar qualification for pensionable appointment. For contract appointments the professional qualification may be waived if compensated by wide experience. Candidates must have served apprenticeship and pupilage in first-class locomotive repair workshop with subsequent experience, and have had at least 10 years on administrative duties in locomotive running department. Drawing-office experience an advantage.

(a) ASSISTANT LOCOMOTIVE SUPERINTENDENT (CDE 110/14/03).

(b) ASSISTANT WORKS MANAGER (CDE 110/14/02).

Appointments are either pensionable or on contract in the scale £650 by £40 to £1290 p.a., with addition up to 20 per cent. for contract appointment. An expatriation allowance varying between £180–£350 p.a. is also payable. Candidates for pensionable appointment should be between the ages of 26–45 years and be A.M.I.Mech.E. or have taken Parts A and B of the examination for Associate Membership and be prepared to qualify during probation. For contract appointments the professional qualification and age limit may be waived if compensated by wide experience.

(a) To assist the District Superintendent (Locomotive) in the general administration of a district. Responsible for maintenance of locomotives and inspection of steam pumps used in connection with water supplies. Candidates should have served an apprenticeship and pupilage in a first-class locomotive repair workshop, and thereafter have had footplate and running shed experience, and have worked at least two years on administrative duties in a locomotive running department. Drawing-office experience an advantage.

(b) Duties include supervision of the locomotive workshop, European and African shop foreman and progress and inspection departments under the jurisdiction of the works manager. Candidates should have served an apprenticeship in a first-class locomotive workshop with at least 2 years' subsequent experience in the organisation and administration of a railway locomotive workshop. They must have had drawing-office experience and have a knowledge of modern progress on production methods.

On contract appointments a gratuity of £100 – £150 per annum is payable on satisfactory completion of contract. Free first-class passages for officer and his wife and an annual maintenance allowance or free passage allowance up to £75 each is payable in respect of a maximum of two children. Furnished quarters available at rental charge of 10 per cent. of basic salary. Leave is granted at rate of 7 days for each month of residential service after tour of 18–24 months. Opportunities for rapid promotion in the higher ranks of Nigerian Railways are good. The progressive growth of traffic and the wastage in senior posts due to normal retirements combine to give excellent opportunities for advancement to men of approved worth.

Apply in writing to the Director of Recruitment, Colonial Office, Great Smith Street, London, S.W.1, giving briefly age, qualifications and experience. Mention the reference number shown against the post applied for. E5781

CITY OF LEICESTER

OFFICE OF THE CITY ENGINEER AND SURVEYOR

ASSISTANT SUPERINTENDENT

Applications are invited for the following appointment in the office of the City Engineer and Surveyor : ASSISTANT SUPERINTENDENT, Sewage Pumping Station, A.P.T. III.

Housing accommodation is available for this post.

Applicants should have experience in heavy steam and electrical pumping machinery, together with qualifications, such as the Higher National Certificate or membership of Institutions.

The above appointment is subject to the provisions of the Local Government Superannuation Act, 1937, and the successful applicant will be required to pass a medical examination.

Application forms may be obtained and should be returned to the undersigned not later than the 7th November, 1953.

JOHN L. BECKETT,
M.Inst.C.E., M.Inst.Mech.E.,
City Surveyor.
Town Hall,
Leicester. E5823

PUBLIC APPOINTMENTS

MINISTRY OF LABOUR AN NATIONAL SERVICE

MECHANICAL ENGINEERING RESEA LABORATORY

EXPERIMENTAL OFFICERS AND ASSISTANT EXPERIMENTAL OFFI

Mechanical Engineering Research Labor East Kilbride, Glasgow (Department of Sci and Industrial Research), has vacancies for engi physicists and mathematicians as Experi Officers and Assistant Experimental Officers. dates for Experimental Officer Posts, Ref. No. 53A, should be at least 26 and have a Pass Deg Engineering, Physics or Mathematics or equi qualification (e.g. Higher National Certi Associate Membership of Institution of Mecha Engineers, &c.). Inclusive annual remunerati a 45½-hr. week, £669–£823 (men). £572 (women). For Assistant Experimental Officers Ref. No. C546/53A, should be at least 18 and the following or an equivalent or higher qua tion :—Scottish Leaving Certificate with pass five subjects. Of these three must be in the H Grade, including two in a scientific or mathem subject. Inclusive annual remuneration for a 45 week, £272–£593 (men), £272–£499 (wom according to age. Prospect of permanent pensio posts for suitable candidates. Houses will be a able for those with householders' responsibili Application forms from M.L.N.S., Technical Scientific Register (K), 26, King Street, Lon S.W.1, quoting appropriate reference above. E57

BRADFORD CORPORATION WATERWORKS

WATERWORKS DEPARTMENT

ENGINEERING ASSISTANTS

Applications are invited for two appointments the Waterworks Department : (a) CHIEF EN NEERING ASSISTANT (Grade A.P.T. X, £89 £1025), and (b) THIRD ENGINEERING ASSI ANT (within Grades A.P.T. I to VI, £465 to £7 The posts are superannuable.

Candidates for appointment (a) should be C porate Members of the Institution of Civil Engine and have had extensive and varied experience on design and construction of works for water supply.

The grade and commencing salary for post will be fixed according to qualifications and expe ence. Some waterworks experience is desirable, not essential.

Applications, stating age, training, professio qualifications and experience, together with the nam of three referees and endorsed "Appointment (a) or (b), Waterworks Dept.," must be delivered to in a sealed envelope not later than the 7th Novemb 1953.

Canvassing will disqualify and an applicant w is related to a member, or a senior officer of Council must disclose the fact in his application.

W. H. LEATHEM,
Town Clerk.
Town Hall, Bradford. E5819

LEEDS CITY TRANSPORT DEPARTMENT

APPOINTMENT OF MECHANICAL DRAUGHTSMAN

Applications are invited for the appointment of MECHANICAL DRAUGHTSMAN.

The salary is in accordance with Grade A.P.T. II of the National Scale (viz. £525 to £570 per annum).

The appointment is subject to the provisions of the Local Government Superannuation Acts, 1937 to 1953, and the successful applicant will be required to pass a medical examination.

Applicants should possess the Higher National Certificate in Mechanical Engineering and have experience in the design and maintenance of workshop plant and lifting appliances.

Applications, stating age, qualifications and details of experience, and accompanied by not more than two recent testimonials, endorsed "Mechanical Draughtsman," must be delivered to me, the undersigned, not later than 9th November, 1953.

Canvassing in any form, either directly or indirectly, will be a disqualification.

A. B. FINDLAY,
General Manager.
Leeds City Transport Department,
1, Swinegate,
Leeds, 1. E5805

MINISTRY OF WORKS

STRUCTURAL ENGINEERING DRAUGHTSMEN

STRUCTURAL ENGINEERING DRAUGHTSMEN required in London, at Risley (Warrington), Harwell (near Didcot, Berks.), Reading and Cambridge.

Accommodation available for single men at Risley and Harwell.

London salary : Up to £628 per annum. Starting pay according to age, qualifications and experience. Rates outside London slightly lower.

Applicants should be experienced in design and/or detailing of either reinforced concrete or structural steelwork. The work is varied and not confined to standard schemes.

Reasonable prospects of promotion. Although not established posts, many have long-term possibilities. Competitions are held periodically to fill established vacancies.

Write, stating age, nationality, experience and locality preferred, to Chief Structural Engineer, W.G.10/S.3 (K), Ministry of Works, Abell House, John Islip Street, London, S.W.1. E5631

THE ENGINEER

OCTOBER 23, 1953

Institution of Mechanical Engineers' Annual Dinner

ON Thursday, October 15th, the Institution of Mechanical Engineers held its annual dinner at the Dorchester Hotel, London. The toast of "The Institution" was proposed by Sir Archibald Forbes, chairman of the Iron and Steel Board. He remarked upon the success of the Institution in making engineering a profession and in raising standards of technical and technological education. Since the war engineering had become more important than ever. In raising the level of exports the nation looked to engineers to improve the efficiency of production and to the profession as a whole to maintain production at the highest possible level. The basic raw material of the engineering industries was iron and steel. The iron and steel industry was aware of its responsibilities, as its performance since the war had shown. The success of the work of the Iron and Steel Board would depend upon its success in gaining the confidence not only of the iron and steel industry, but also of all users of iron and steel. Any help the Institution could give would be very much welcomed. In reply, Mr. Roebuck, president of the Institution, referred to the great privilege he had had as president of attending the Coronation in the Abbey and the review at Spithead. He remarked also that the Institution had recently had a very good summer meeting in Sheffield. In referring to other activities of the Institution during the year, he remarked that the issue of the *Journal* in a new form was being considered, and referred also to a gift to the Institution by Lord Weir of £10,000. It was intended to use this sum to provide a graduates' and students' prize, to supplement the "Students' Aid Fund," and to make grants for particular purposes to graduates and students' sections of the Institution. Dr. R. W. Bailey, vice-president, proposed the toast of "The Guests." The response was made by the Very Rev. Alan C. Don, Dean of Westminster, who, in a reference to the Westminster Abbey appeal, said how honoured they were at the Abbey to be responsible for so many memorials and tombs of famous engineers.

Particle Accelerators at Hammersmith Hospital

Two atomic particle accelerators have recently been installed on behalf of the Medical Research Council in a new building at the Hammersmith Hospital, London. In a room at the south end of this building there is an 8MeV linear accelerator and another room at the north end will house a 45in cyclotron. Research laboratories and clinical rooms for patients occupy the central portion of the building. The linear accelerator, which is the first to be built for X-ray therapy, was designed by the Ministry of Supply Atomic Energy Research Establishment and the Radiotherapeutic Research Unit of the Medical Research Council in collaboration with Metropolitan-Vickers Electrical Company, Ltd., who constructed the machine. In this travelling-wave accelerator electrons attain an energy level of 8,000,000 electron volts and, after striking a gold target, produce highly penetrating X-rays. Simple joystick controls are provided for the angular movement of the X-ray tube and the position of the floor and couch so that the beam can be directed into the patient at any angle. The collimated X-ray beam is of sufficiently high intensity to allow the delivery of a high dose to a deep-seated tumour, with a treatment time of about two minutes, and without any danger of damage to the patient's skin. Although a long time must elapse before the value of this form of therapy can be assessed, it has two advantages—the absence of skin reaction and the fact that a greater number of patients can be treated in a given time, than with the less powerful X-ray generators. Concrete walls 4ft to 6ft in thickness enclose the linear accelerator, giving more protection than is required for safety of personnel and enough to prevent interference with the measurement of minute quantities of radio-active materials in adjacent laboratories. A periscope system allows the patient to be kept under observation during treatment, all the X-ray controls being centralised in a desk outside the treatment room. The 45in cyclotron, which is under construction, will be housed in a separate room with concrete ceiling and walls from 6ft to 10ft thick. The cyclotron will be used to produce an intense beam of high-speed neutrons with a view to assessing the value of neutrons in the treatment of malignant disease. Another use is the production of certain radio-isotopes which have a very short life.

The South Bank of the Thames

THE London County Council has received a report from its general purposes committee setting out proposals for the permanent development of the South Bank of the Thames. The area covered by these proposals is bounded by Waterloo Bridge, York Road, Chicheley Street, and the river, though for the sake of completeness one or two suggestions for adjoining sites have been included in the scheme. The scheme envisages major public buildings with frontages to the riverside public open space, already approved by the Council, consisting of a strip of land along the river front in general about 100ft wide. A site already reserved for the National Theatre now adjoins the County Hall and is separated by a large public square running back to Belvedere Road from a site of 1·6 acres proposed for a hotel. The site between Belvedere Road and York Road, covering 4·7 acres, is recommended for office buildings and for an air terminal. On the part of the site downstream from Hungerford Bridge provision is made for an international conference centre, which is linked physically with an extension of the Royal Festival Hall by a building designed as an exhibition gallery, these buildings again forming a large open square facing the river. The area of 1·8 acres between York Road and Belvedere Road is reserved for office development. The scheme provides for car parks under the riverside open space and under the two adjoining squares upstream and downstream of Hungerford Bridge, besides those to be provided by individual developers under their own schemes. Covered space would thus become available for about 1000 cars and it is not proposed to make provision for surface parking. Concerning the development of adjoining sites, the committee's report says that the scheme indicates a possible helicopter landing site on the roof of Waterloo Station. The report concludes by saying that the time within which the development of the area can be carried out depends mainly on the extent to which the Government will permit capital expenditure for works of this nature.

Lloyd's Shipbuilding Returns

LLOYD'S REGISTER OF SHIPPING has published this week its shipbuilding returns for the quarter ended September 30, 1953. The figures for Great Britain and Ireland record that work in hand amounted to 316 steamships and motorships of 2,190,329 tons gross, which represented an increase of 66,764 tons over the previous quarter, and of the total 91 ships of 641,645 tons were fitting out, while the remainder were still to be launched. During the quarter 47 ships of 289,233 tons were commenced and 57 ships of 323,414 tons were launched, those completed totalling 47 ships of 218,967 tons. There was a total of 104 oil tankers of 1,178,526 tons, a decrease of 33,526 tons, compared with the previous quarter, and representing 53·8 per cent of the total tonnage under construction. Plans have been approved and material ordered for 2,286,174 tons of shipping, some 105,107 tons less than the quarter ended June 30th. The returns for shipbuilding abroad, excluding China, Russia and Poland, show that 787 steamships and motorships of 3,801,100 tons gross were under construction, a reduction of 112,767 tons compared with the June quarter, and that 186 ships of 711,816 tons were commenced, 225 ships of 888,302 tons were launched and those completed totalled 233 ships of 833,874 tons. Oil tankers under construction amounted to 194 ships, representing 2,210,589 tons and 58·2 per cent of the total tonnage being built abroad. Apart from the excluded countries, the work in hand in the world amounted to 1103 steamships and motorships of 5,991,429 tons gross, of which 36·6 per cent is under construction in Great Britain and Northern Ireland. The total included 160 ships of between 10,000 and 15,000 tons, 40 ships between 15,000 and 20,000 tons, and 35 ships of between 20,000 to 30,000 tons each. In Great Britain and Northern Ireland there were 1,151,599 tons of steamships and 1,038,730 tons of motorships, while the corresponding figures for abroad were 1,881,076 tons and 1,920,024 tons respectively. Oil tankers under construction throughout the world totalled 298 ships of 3,389,115 tons, which represents 56·6 per cent of the total tonnage being built, and includes 130 steamships of 1,885,336 tons, the remainder being motorships. Of the world total tonnage under construction, 3,956,509 tons, or 66 per cent, are being built under the inspection of Lloyd's Register.

British Petroleum Equipment

THE tenth annual general meeting of the Council of British Manufacturers of Petroleum Equipment was held in London on Thursday of last week. It was preceded by a luncheon, at which Mr. Douglas Wilson, the chairman of the Council, presided, and at which Mr. Geoffrey Lloyd, Minister of Fuel and Power, was the guest of honour. Proposing the toast of "The Guests," the chairman recalled that between 1947 and 1953 the oil refining capacity of the United Kingdom had increased from 2,500,000 tons a year to over 25,000,000 tons, thus making it the largest in Western Europe. In addition, he said, equipment for drilling and refining and for pipelines, formerly only obtainable in the U.S.A., had now become a dollar earner. These things indicated that the United Kingdom would be able at least to keep abreast of any other country in research and in the expansion of facilities to meet the ever-rising demand for oil. Mr. Wilson went on to say that the Council was well aware of the process research being carried out by the individual oil companies, but it felt that if the United Kingdom was to achieve independence and continue its progress in the right direction, a great deal more in the way of research must be done. The Council proposed, therefore, to foster, encourage and use every means at its disposal to increase research into the thermo-physico-chemical properties of petroleum. Responding to the toast, the Minister of Fuel and Power said that in the ten years of the Council's life the industry supplying petroleum equipment in this country had developed into something of very substantial and growing importance. Now that the equipment industry was established and going on well, it was time to make suitable preparations for practical developmental research which would enable the British industry not only to produce current equipment, but also to have the advanced technical knowledge which would enable it to produce increasingly better designs and equipment than could other people.

North of Scotland Hydro-Electric Schemes

No. V—SOME SCHEMES FOR LOCAL SUPPLY*—PART II

(*Concluded from page* 485, *October* 16*th*)

One aspect of the hydro-electric developments which have been in progress in Scotland since the war concerns the construction of small schemes, in isolated areas, for the production of electrical power to meet local demands. The North of Scotland Hydro-Electric Board's various schemes in this category are described hereunder.

TO the south-west of the area supplied by the Cowal scheme lies another isolated area—the Kintyre peninsula—to which power is now supplied by the Lussa hydro-electric scheme. The principal centre of consumption is Campbeltown, but there are farms and coastal villages on both sides of the peninsula which receive a supply from the scheme. The principal data of the scheme are given in the table on page 516. Its layout follows the usual pattern of reservoir, collecting aqueducts and diversion works to the power station. The reservoir has a normal top water level of 450 O.D., and storage equivalent to 20 per cent of the annual output. The power station is in Glen Lussa, with a gross head of 373ft. The short power tunnel is ¾ mile in length, followed by a pipeline with low and high-pressure sections totalling about 2 miles in length. The low-pressure section is 60in in diameter and about 2250 yards long; there is a surge pipe at the end of it, where it joins the high-pressure section, which is 48in in diameter.

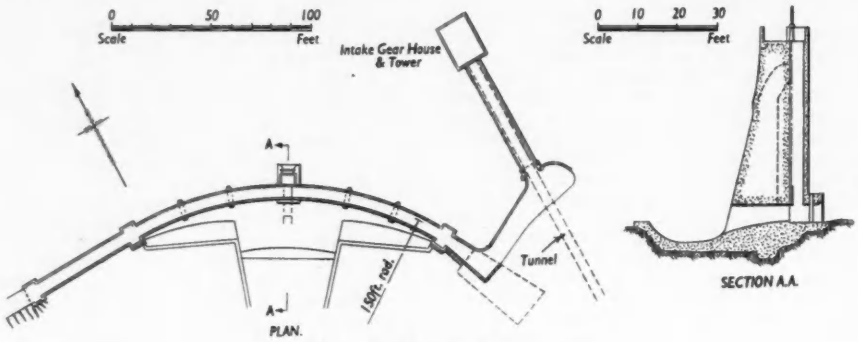


Fig. 7—Glen Lussa Dam

Welding of the pipe joints was carried out *in situ*, the sleeve joints being welded inside and outside. The finished joints were tested by pumping kerosene under pressure into the annular space between the inside and outside welds. The mobile welding plant, mounted on bogies, was carried on a light railway constructed alongside the pipeline throughout its whole length. The pipeline is supported on concrete pedestals and at ravine crossings by fabricated steel trestles on concrete footings.

The dam is a small one, constructed in a gorge in the Strathduie water, and is an arch structure. It is illustrated in Figs. 7 and 8; the crest length of the arch section is 160ft.

The provision of a normal vertical surge shaft at the end of the low-pressure pipeline was not a practical arrangement, and an inclined surge pipe was incorporated in the works. This pipeline runs up the hillside from the junction of the low-pressure and high-pressure pipelines to a point where it also serves to collect the water from diversion aqueducts which derive from the headwaters of several streams. The surge pipe rises over its entire length of approximately 1420ft, the maximum gradient being 1 in 7. The lower section of the pipe is 60in internal diameter and ½in thick, but over the last 750ft of its run the diameter is increased to 84in, the thickness being unchanged. The water surface is always within the latter section and, due to the inclination of the pipe, an effective surface area of 270 square feet is provided, corresponding to a vertical shaft of approximately 18ft 6in diameter and providing equivalent stability conditions for fluctuations in load.

The power station contains two 1780 h.p., 335ft head horizontal reaction turbines, each driving a 1000kW, 1000 r.p.m., 11kV, 0·85 p.f. alternator with a 25 per cent overload capacity for two hours. At a point immediately upstream of the power station the 48in pipeline divides into two 33in diameter branches to feed each turbine through a hydraulically operated sluice valve. Each valve is provided with a hydraulically operated by-pass valve to permit priming of the spiral casing and balancing the pressure across the sluice valve before it is opened.

The turbine runner is overhung from the alternator shaft and there is therefore no intermediate turbine bearing. The spiral casing is of cast iron in two halves bolted together to permit removal of the runner, if necessary. The regulating gear, consisting of the regulating ring and guide vane levers, is on the alternator side of the turbine with the draught tube on the opposite side. The relief valve is mechanically operated from the governor and is connected to the inlet pipe, discharging into the draught tube pit. The governor actuator and the governor oil pump are both belt driven from the alternator shaft.

The set is suitable for starting and stopping from a remote point, and since the governor oil pump is belt driven and there is no oil pressure reservoir, the turbine guide vanes are opened by a water-pressure-operated servo-motor acting on the regulating ring. The servo-motor opens the gates sufficiently to allow the turbine to run up to speed, when the oil pressure builds up, the governor takes control and the servo-motor is cut off. The water pressure to the servo-motor is controlled by a solenoid-operated pilot valve.

The alternator is a two-pedestal-bearing machine, mounted on a bedplate, with open circuit ventilation, the bearings being flood lubricated through a pressure reducing valve from the governor oil system. Because of the high voltage for the comparatively small output, a hairpin winding is used instead of a basket one. The rotor and shaft is a one-piece forging with the six poles fixed by fitted dovetails. A 10⅝in thick, 60in diameter steel plate flywheel is shrunk on the shaft to give the large flywheel effect needed for the arduous pipeline conditions. A single two-endshield-bearing exciter is provided for each set, direct coupled to the alternator, and an overspeed device is fitted on the free end.

The two alternators are connected to 11kV switchgear from which the power is transmitted at 11kV to Campbeltown.

The sets can run unattended and shut down automatically in the event of a fault. Provision is also made for complete remote control from Campbeltown, under which

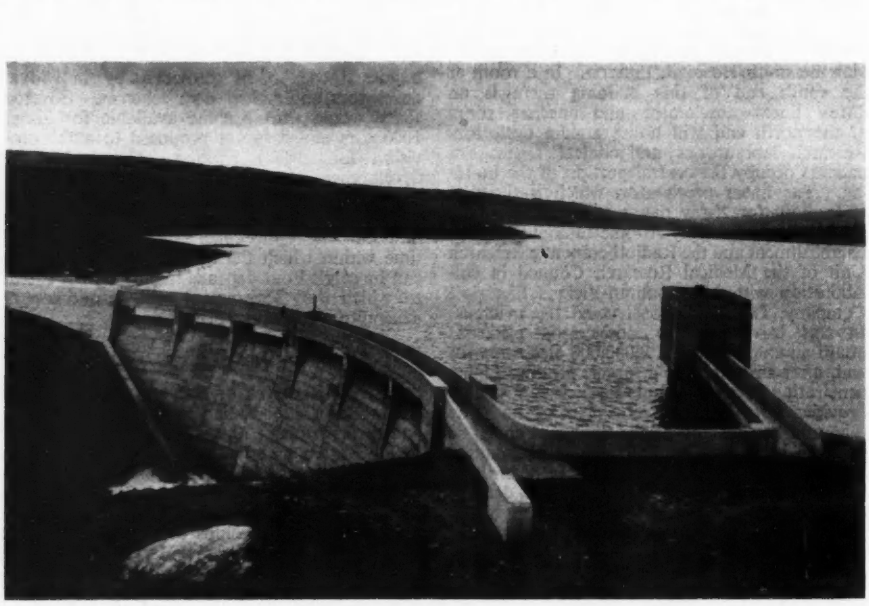


Fig. 8—Glen Lussa Dam and Reservoir

* No. I, "An Introductory Survey," appeared on July 14, 1950; No. II, "The Loch Sloy Project," July 21-August 4, 1950; No. III, "The Fannich Project," June 8–15, 1951; and No. IV, "The Mullardoch-Fasnakyle-Affric Project," April 11-25, 1952.

the sequence of operations on starting would be as follows :—

The starting impulse from the remote point first closes a master contactor which initiates (*a*) opening of turbine inlet valve by-pass ; (*b*) preparation for opening of turbine inlet valve ; (*c*) starting of excessive-starting-time protective relay. The by-pass valve and the main inlet valve then open, filling the spiral casing. When the main valve is fully open an auxiliary contact on it energises a solenoid which causes the starting servo-motor to open the turbine gates. The turbine then starts and the governor oil pressure and bearing lubrication are built up. The turbine governor takes control and the starting servo-motor is de-energised. Then the automatic synchronising equipment is brought into operation and the main circuit breaker is closed. Finally, the voltage and output are adjusted by the automatic voltage regulator and the governor speeder-motor. A set is shut down by reducing the output until the turbine gates are fully closed. The main circuit-breaker is then tripped and the master contactor opened, which closes the turbine inlet valve and causes the set to stop.

The network of transmission and distribution lines associated with the scheme link it with the Board's diesel stations at Campbeltown and Ardrishaig ; one line extends from Southend, near the Mull of Kintyre, along Loch Fyne to the substation of the Shira scheme.

The consulting engineers for the Lussa scheme are Messrs. James Williamson and Partners for the dam, tunnel and diversion aqueducts and Messrs. Strain and Robertson for the pipelines, power station and generating plant. The main contractors were John Woodrow and Sons (Builders), Ltd., Wilson, Kinmond and Marr, Ltd., the English Electric Company, Ltd., Stewarts and Lloyds, Ltd., Glenfield and Kennedy, Ltd., and B.I. Callender's Cables, Ltd.

Storr Lochs

Unlike the schemes at Cowal and Lussa, which have been described above, the Storr Lochs power station, which is situated in the Island of Skye, has no connection at all with the Highland grid. However, it operates in parallel with the power station of the Lochalsh scheme, which is situated on a neighbouring part of the west coast 52 miles away, and supplies the southern part of Skye with power through a 22kV submarine cable and overhead line.

The Storr Lochs scheme consists of a gravity dam 179ft long and 36ft in height, which forms a reservoir by enlarging and joining together two natural lochs, and a pipeline 2800ft in length, leading from the reservoir down to the power station situated on the seashore near the mouth of the Bearreraig River. Two 800kW horizontal Francis turbine sets have been installed, and provision has been made for duplication of the pipeline and for the installation of a third set in the power station. The storage capacity of the reservoir is equivalent to 24 per cent of the annual output. For constructional purposes an inclined railway has been built up the steep hillside close to the power station ; it is fully automatic, with push-button controls and is powered by an electrically driven winch, situated in a winch house at the top of the slope. The power station machinery is manually started, but runs with fully automatic protection.

The distribution of power from Storr Lochs power station has entailed about 330 miles of high- and low-tension lines, which serve about 85 per cent of the Island population of just over 10,000. The area of Skye is 690 square miles.

The consulting engineers for the Storr Lochs scheme are Messrs. Blyth and Blyth for the civil engineering, the electrical and mechanical consultants being Messrs. Kennedy and Donkin. The main contractors were James Miller and Partners, Ltd., for the civil engineering works, and Gilbert Gilkes and Gordon, Ltd., for the power station machinery.

Gairloch

On the West Coast of the Scottish mainland to the north of Skye, the coastal district of Gairloch-Aultbea in Ross-shire, is now supplied with power from the Kerry Falls power station of the Gairloch hydro-electric scheme. This development consists of a regulating weir across the River Kerry at the outlet of Loch Bad-an-Sgalaig, which raises the level of the loch by 12ft and provides the necessary storage, totalling 141 million cubic feet. About half a mile down the river from the regulating weir there is an intake weir, from which a pipeline 4300ft in length leads to the power station.

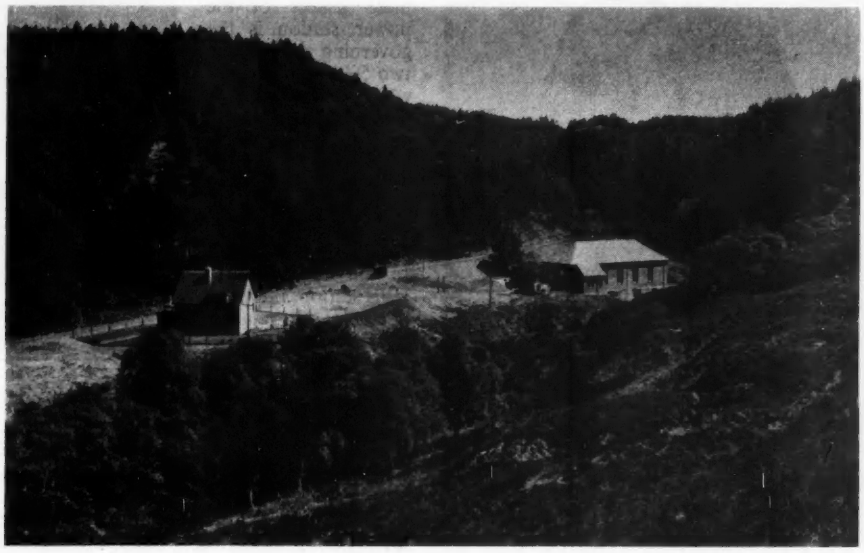


Fig. 10—Kerry Falls Power Station

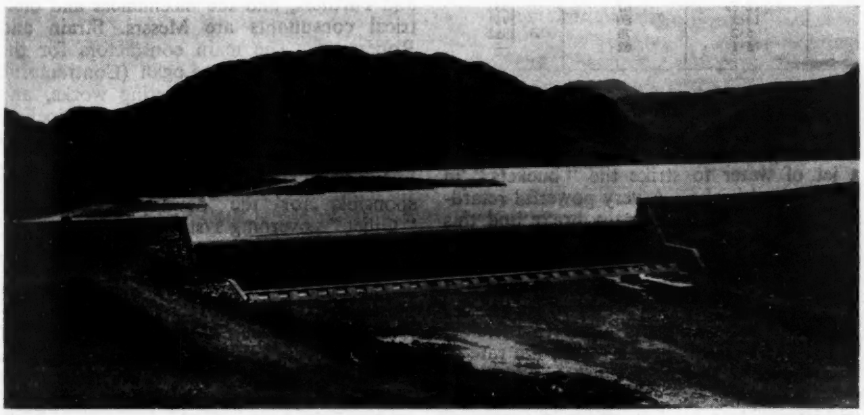


Fig. 9—Regulating Weir for Gairloch Scheme

The regulating weir is shown in the accompanying illustration, Fig. 9 ; the Rehbock sill may be noted. From this weir there is a 42in diameter concrete pipe 500ft in length, laid below the river bed, with a needle valve at its outlet, discharging back into a channel excavated in the bed of the River Kerry. The draw-off pipe and channel are below river bed level so as to permit water in Loch-bad-an-Sgalaig to be drawn down to a lower level than would otherwise be possible. The needle valve is controlled by the level of water in the intake pond and thus discharges the flow required for the power station. An alarm circuit, actuating bells in the power station and attendant's house, operates when the water level at the intake pond falls below a certain level and if the water level continues to fall the machines will be tripped-off load.

The intake weir itself is generally similar to the regulating weir, and provides sufficient storage for a day's operation of the power station at average water consumption. The power station intake incorporates the usual screens and guard and control valves. An over-velocity valve is to be fitted when the station is shut down this year for the installation of the third turbo-alternator set. The first 800ft of the 48in diameter steel pipeline from the intake weir is encased in concrete to protect it both from falls of rock from the cliff face under which it passes and from damage which might be

caused by floods in the river. The pipeline traverses some very awkward slopes along the side of the Kerry Falls gorge and its construction was difficult. Generally it consists of 25ft 6in lengths of pipe with welded joints, carried on concrete pedestals with "Tufnol" bearing pads. Sliding expansion joints were incorporated between the anchor blocks, which were up to a maximum distance of about 300ft apart.

At one point the pipeline is carried on a steel trussed bridge of 110ft span. Close to this point it is laid with a rising gradient for some distance and an air valve is incorporated at the "peak" level. The gradient then continues to fall gradually until a point close to the power station is reached, when it descends sharply, trifurcating at the low level into one 24in and two 34in pipes, one leading to each turbine. At the change in gradient, a blank flange has been incorporated, so that a surge pipe may be added later if it proves to be necessary.

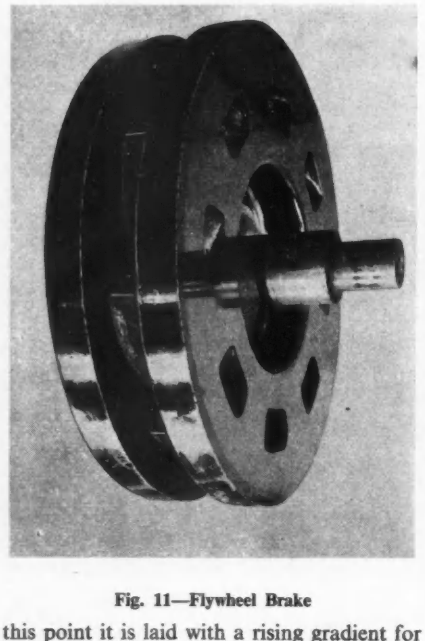


Fig. 11—Flywheel Brake

The data for the Gairloch scheme shown in the accompanying table give its ultimate installed capacity and output. At present there are two machines in operation—a 250kW "Turgo" impulse set, and a 500kW horizontal Francis turbine set; a second similar 500kW set is to be added later this year to bring the scheme to its full capacity. Each machine is connected directly to a step-up transformer and all switching is done at 11kV, at which voltage supplies are given to the distribution network. The outgoing feeder to the network is provided with automatic reclose mechanism to deal with transient faults, thereby reducing outages. The generating plant is designed to run unattended and has various protective devices to bring it safely to rest in the absence of the attendant, who has other duties to perform outside the power station.

Scottish Hydro-Electric Schemes for Local Supply

Scheme	Estimated annual output, kWh × 10^6	Installed capacity, kW	Gross head, feet	Catchment area, square miles	Average annual rainfall, inches	Year of completion
Morar	2	750	16	65	100	1948
Lochalsh	4	1250	490	7·3	68	1948
Gairloch	4	1250	185	13	76	1951
Lussa	8·5	2400	380	12·6	67	1952
Cowal	14	6000	403	14·5	80	1951
Storr Lochs	3·5	1900	447	5·2	79	1952
Loch Dubh	4	900	513	5·1	62	—

The power station is of pleasing appearance with a slate roof and walls of local stone, with the attendant's house built close to it, as shown in Fig. 10. Just downstream of it in the Kerry River a fish heck has been built and a by-pass pipe from the generating station is provided so that the required minimum amount of water can be maintained in the river when the station is on light load or not in operation.

An interesting technical aspect of the power station is the governing gear for the two 500kW machines, which incorporate a new system of governing, designed primarily to limit the magnitude of the surge occurring in the penstock when load conditions are changed. In the case of Kerry Falls station, the pipeline is long in relation to the head—4300ft and 185ft, respectively—and the improvement given by the new governing gear, known as the "Giljet" governor, has, we understand, made the installation of a surge pipe unnecessary.

The turbine guide vanes are connected to the rocking shaft of a conventional oil pressure governor having its pendulum and oil pump independently driven by belt from the turbine shaft. The operation of the "Giljet" governing system depends on "buckets" formed in the rim of the flywheel, which is mounted between the turbine alternator coupling faces and is surrounded by a steel casing of special design. These buckets rotate against a jet of water similar to the jet of a Pelton wheel, the rate of flow of water through the jet being varied by a spear valve. Under normal working conditions when the load is constant, the spear valve is closed and the flywheel brake rotates freely within its casing.

When a heavy load is thrown off, the speed rises causing an initial closing movement of the turbine governor. This closing movement immediately opens the spear, allowing a jet of water to strike the "buckets" in the flywheel brake. A very powerful retarding torque is applied to the brake and this has the effect of immediately checking any further speed rise. The closing of the turbine guide vanes has been small and the reduction of flow of water through the turbine is approximately equal to the flow through the nozzle. As a result, the rate of flow of water in the pipeline is practically unaltered and the speed rise is checked within a few per cent above the normal speed.

A dashpot is incorporated in the linkage between the governor rocking shaft and the spear valve. This dashpot allows the spear to close slowly, hence reducing the braking load and allowing the turbine guide vanes to close exactly as they would do were the electrical load to be reduced over a period of, say, 60 seconds, instead of instantaneously.

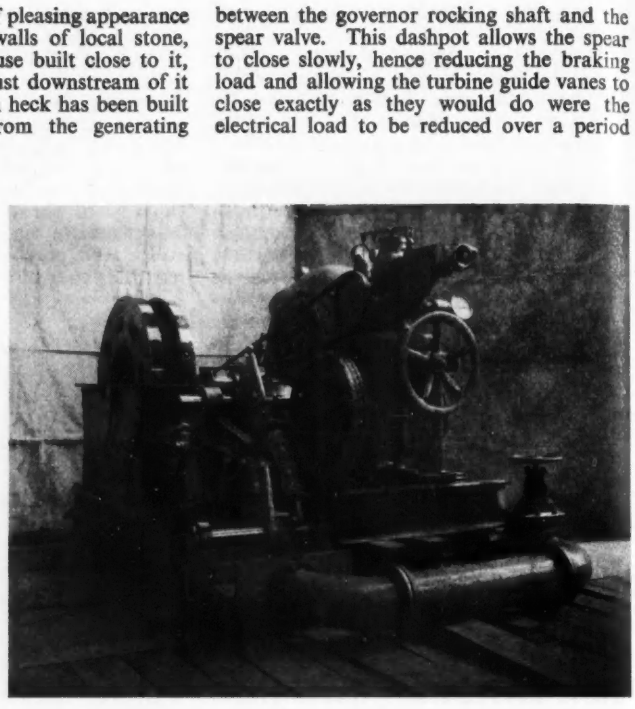


Fig. 12—Shop Assembly of Francis Turbine Showing Governor Gear

Fig. 11 shows the flywheel brake, indicating the construction used to give maximum power absorption when the brake is loaded and minimum windage loss under normal operating conditions. Fig. 12 shows the shop assembly of the unit with the top cover of the "Giljet" casing removed. In the immediate foreground the pipe connecting the turbine casing to the spear nozzle can be seen, and also the connections between the spear and the governor rocking shaft, together with the adjustable dashpot forming a portion of the linkage.

Many governing tests were carried out by the makers of this gear, and it was found that with full load instantaneously thrown off the maximum speed rise did not exceed 6 per cent above the final settled speed, whilst the pressure in the penstock only rose to a few per cent above the static head. One of the most searching tests applied was to throw-off full load and in three seconds re-apply this load by making the breaker. The operation of the governor was entirely stable and here again the pipeline pressure barely rose above the static head.

The consulting civil engineers for the Gairloch scheme are Sir William Halcrow and Partners, and the mechanical and electrical consultants are Messrs. Strain and Robertson. The main contractors for the scheme were Duncan Logan (Contractors), Ltd., for the civil engineering works, and Alex. Findlay and Co., Ltd., for the pipeline, whilst the main power station machinery was supplied by Gilbert Gilkes and Gordon, Ltd. The last-named firm was also responsible for the development of the "Giljet" governing system.

Loch Dubh

The Loch Dubh project is also situated in Ross-shire, a little further north from Gairloch, on the West Coast. Unlike the other schemes mentioned in this article which are now all in operation, construction of the Dubh scheme was started in late 1952. It is expected that power will be generated early in 1955.

The scheme will supply an area of about

220 square miles around Ullapool and Lochinver, the power station being situated in Strath Kanaird, about 4 miles north of Ullapool. An intake dam is now under construction, about 35ft in height and 260ft long, from which a 27in diameter steel pipeline, 3700ft long, will carry water to the power station. A second dam is being built at the outlet of Loch Dubh to form the storage reservoir. This structure will be about 51ft in height and 220ft long, and, as with the intake dam, it will be of mass concrete gravity construction. The ultimate capacity of the power station will be 900kW with a gross head of 513ft.

The consulting engineers for the Loch Dubh scheme are Messrs. Blyth and Blyth for the civil engineering, and Messrs. Strain and Robertson for the electrical and mechanical work respectively. The main civil engineering contractors are R. J. McLeod (Contractors), Ltd. The turbo-alternators are being supplied by Messrs. Gilbert Gilkes and Gordon.

Craftsmanship

By A. ROEBUCK

In his Presidential Address to the Institution of Mechanical Engineers last Friday, October 16th, long extracts from which are printed below, Mr. Roebuck stressed the importance of craftsmanship. He expressed also his conviction that professional engineers through an understanding and knowing of craftsmanship have a great potential power to foster goodwill and co-operation in industry.

As one grows older one realises more and more that man's attitude to man, human values and relationships are so fundamental in our social structure and in our industrial life. One of our greatest needs to-day is to seek and apply more understanding in our association and relationship with our fellow beings. My long experience with a great firm in an industry which has a high reputation for long service amongst its employees, has taught me how essential it is that these relationships should be right. It seems to me that professional engineers carry a special responsibility for fostering a spirit of co-operation, for many of us must not only set the pace technically but also give leadership to others as managers of men. I believe that our time this evening will best be employed if I develop this theme of improving the relationships between the different types of engineering personnel and if I give you, for what it is worth, the benefit of my own experience and the lessons I have learnt from it.

It is well-known that during the 1939–45 war a remarkable degree of co-operation was achieved both in the services and in industry, and that this spirit of goodwill arose from the sense of common purpose that united all ranks and types of employee. This was to be expected in a period of acute national emergency which always brings out the best in the British character, but there have not been lacking many industrialists and leading trade unionists who regret that this feeling of common purpose seems to be missing in the less obviously urgent circumstances of to-day. And yet most of us know and admit, if we are honest, that the national need is just as great to-day, and as engineers we have a particularly important part to play in solving our national difficulties. As Sir Lincoln Evans, the deputy chairman of the new Steel Board said recently, " We have in this land of ours great resources in the inventive genius, the technical ability and the craftsmanship of our people. All we require is a clearer recognition of our great need to use them fully if our struggle for economic survival and independence is to be won, for the stakes are no less than that." My long experience as an engineer has taught me that one does not get the best —in a technical and craft sense—out of people unless the human relationships are good, and conversely, that good relationships can be built upon the common bond which joins those engaged in a highly technical enterprise provided that those who carry out the various functions necessary to that enterprise—design, manufacturing, selling and accounting—recognise in each other the particular skills and aptitudes associated with the part each has to play, and provided that they respect those diverse skills and aptitudes.

In our various discussions about education and training we have come to recognise three broad groups of skilled personnel in engineering : professional engineers, technicians and craftsmen. There are always dangers in attaching labels to people, and I would be the last to try to differentiate rigidly between the degree and quality of knowledge, skill and aptitude associated with each of these groups. Fortunately in Great Britain free movement from one to another of these groups is possible, and many senior members of our Institution provide living evidence of this. It is not easy in all cases to be precise about the label that applies because the duties of craftsmen and technicians overlap and many professional engineers gained valuable experience while working as technicians. The relation between the fully-fledged professional engineer and the technician is usually close and arises naturally from the fact that the two are often intimately associated in their daily work.

I think it is possible, however, that professional engineers do not always think sufficiently about their relation to the craft group and about the great potential power they have to foster goodwill and co-operation. This, perhaps, particularly applies to the younger members of the profession and I think that we older professional engineers have a special duty to discharge in bringing up in the right way those youngsters who aim from the beginning at professional status, and who in the nature of things in to-day's easier industrial school—I think of the young engineering graduate who does not go through the mill as I once did—must be helped to establish the correct man-to-man relationship with the craftsman in the workshop.

We ought to remember that without the craftsman—the man at the bench or machine —the work of professional engineers and technicians would be of no avail, but, on the other hand, if the craftsman is left to himself he will produce an answer—not necessarily the best possible answer but a satisfactory one nonetheless—as any of my listeners who know something of, say, the maintenance problems in a steel works will readily appreciate. In his designs the professional engineer must, of course, give the customer what he wants but for the rest I do not think that he can go far wrong if he has the man in the workshop constantly in mind, and aims to make the latter's task as efficient and speedy and comfortable as possible. In other words, the energy of the professional engineer should be particularly directed towards efficiency at the working point. The engineer can also play his part as a good manager of men by making sure that the craftsman's environment is such that he gives willingly of his best. This, of course, is not simply a matter of providing good welfare facilities, though good canteens, medical facilities and playing fields, and so on, are good in themselves ; the fact is that many of us know that the contentment which produces good work well done is at a deeper level than welfare as conventionally understood.

We know from experience that people will accept great hardship and discomfort in their work and in an emergency will endure actual physical pain if there is a direct appeal to all that is best in their character. I do not think there is much doubt that the true engineering craftsman will do without a lot that goes by the name of welfare if his creative energies are allowed full scope. It is at least one of the tasks of the professional engineer to call forth such a response in the craftsman, and he cannot be reckoned to be a leader in the true sense of that word unless he is discharging this responsibility. Incidentally, my last trip to the United States, when leading the productivity team on " Materials Handling in Industry," convinced me that many responsible engineers in that country are exercising sound leadership, and I was really impressed with the resulting attitude of employees to the vital matter of production by the most efficient methods. They seem to appreciate the way in which this is linked with their own prosperity. I may mention as an example my visit to the research department controlled by one of the unions of skilled engineering workers where I learnt that one of their functions was to send trained production experts to backward firms ; in other words, the union itself was willing and anxious to help managements to improve their production capacity so that the workers themselves could be more assured of continuity of employment.

Engineering has, of course, grown much more complicated during the last three or four decades and there has been a corresponding increase in specialisation in the work of engineers. At the same time there has been a drive towards greater simplification of work processes and a concurrent tendency towards line production in certain industries and, where this has been adopted, it has often resulted in production on an increasingly large scale. The result has been that in certain industries the demand for high-grade craftsmen actually working on the production line has lessened but within the overall structure of Britain's productive capacity highly-skilled craftsmen are still essential in even larger numbers than formerly. In round figures, about one-third of the total numbers in civil employment are women, leaving something under 15,000,000 male workers aged fifteen or over who work for pay or gain. How many of these male workers are craftsmen ? Looking a little closer into the various categories of workpeople engaged in the engineering industries of Great Britain under the headings : fitters, turners, patternmakers, moulders, sheet-metal workers, blacksmiths, and platers, it is estimated that in these trades there are persons numbering

something over half a million skilled workers. It is to such workers as these that I draw attention. These are the workers skilled in production and amongst them are the real craftsmen. Let us never forget the essential function they all perform in delivering the goods. The scientific and research workers, the administrators, the designers, the cost accountants, the planners, form only part of a team and, without the workshops and the men in them, would soon fall by the way.

There is another point that I would like to make here : to-day our whole educational system tends to sort out youngsters into " layers " at a very early age, and although in engineering, as I have indicated already, we go to some trouble in Britain to ensure that movement from one layer to another is possible, we are perhaps in danger as a nation of attaching the wrong kind of value to this sorting-out process. The whole weight of this system seems to make our youngsters rate brain work as something superior and more to be sought than hand work. It is not simply a question of financial rewards, since many of you will know of instances in which the practical man in the workshop gains greater remuneration than the worker in the office. It is easy to recognise the danger of this and we ought to be particularly careful as professional engineers to ensure that in our personal attitudes we do not encourage this danger. Those of my own generation need no reminding of the sterling qualities of the true craftsman—we older ones are so used to giving due recognition to those qualities that it has become an unconscious process with us ; when we go into the works we talk quite naturally to such craftsmen as man to man, and there is a mutual confidence and respect —and indeed affection—in our relationship. Confucius asked : " How may I recognise a great craftsman ? " and answered his question as follows : " First by the reputation of his ancestors for honesty and sincerity ; then by his ability to create something new from an experience that is old." This perhaps puts in a nutshell the attitude of many of us older persons if we do but analyse our thoughts on this question. But the university or grammar and public school product of to-day normally lacks true background for this understanding ; I do not necessarily blame those youngsters who lack this appreciation for the moral is, I think, that we older professional men must get it over to the younger ones that one of the lessons they have to learn is respect for skill and ability in engineering no matter what form it takes and that to have a capacity for abstract thought is not necessarily a greater gift of nature than to have the peculiar gifts of the craftsman which, in fact, have much in common with those of the creative artist.

If mutual confidence and respect can be established on such a realistic technical basis we older ones know from experience that it is much easier to settle the differences which arise in other fields, and it is not part of my purpose to suggest that such differences do not exist. In short, in engineering no one group is any " better " than another. Whether as professional engineers, as technicians, or as craftsmen, each is vital to the success of all, each has a unique contribution to make, and the ideal is that each person should be free to develop his particular aptitudes and qualities so that he gives the very best of which he is capable. The engineering industry is well placed to set an example in achieving good human relationships. One can quickly establish the right relationship with a man by an approach to him on the level of his technical abilities and aptitudes ; he takes pride in these abilities and aptitudes and his self-respect is to a great extent based on them. This is a much firmer ground for a real relationship than economics or social outlook. Where employers, managers, and men can approach each other on this basis I do not think there need be great worry about industrial co-operation.

It is, of course, obvious that the education and training of our young budding mechanical engineers must play a vital part in our thoughts and it will not be out of place for me to make a few remarks on this and allied subjects.

For a start let us look at the qualifications necessary for one to become a Corporate Member of our Institution. In By-law 13, dealing with Associate Members (who are the backbone of our Institution), these words appear :—

(*a*) Has been regularly trained as a mechanical engineer.

(*b*) Has had sufficient practical experience in mechanical engineering.

As you are aware the council at their meetings elect new entrants, but the detailed work of analysing candidates' qualifications and making recommendations to the council regarding election is done by the membership committee. I would pay tribute here to the skilled and patient work of the members of this committee upon whose shoulders the very status of the Institution depends. The rules governing examinations do not generally present difficulty in interpretation, but quite often it is not a straightforward matter to obtain a true measure of a candidate's practical experience under headings (*a*) and (*b*) above. Whereas the practical training gained during a regular apprenticeship in a reputable works is fully satisfactory for the purpose, difficulty may be experienced by the university graduate who, although he has taken, say, an honours degree, has then taken a short cut in his training by accepting a staff appointment immediately after graduating and has thus by-passed the vital period of practical work when he should have been employed as a " hand " in an industrial organisation. We all fully recognise that such men sometimes experience real difficulty in acquiring a sufficient period of practical experience either in vacations or after taking a degree, but I can vouch personally for the great value of such a period of training. It is of inestimable value to the man in his later life because it gives him a confidence and effectiveness in leadership that book work cannot possibly provide. It is in these cases that the membership committee experience great difficulty in deciding whether or not the qualifications are up to the standard required.

It is perhaps not always remembered that under the strict indenture system which operated in the middle ages in connection with the craft guilds, the master craftsman accepted a much wider responsibility for his apprentice than was called for in merely teaching him his trade ; he was responsible for the apprentice as a person and was expected to give him guidance in all spheres of life and help him to develop his character. Gradually the craft guilds became redundant and gradually, too, apprenticeship became less comprehensive and more narrow in its aims. Lately, I am glad to say, there has been a swing back to the outlook adopted in the middle ages and many firms have accepted their responsibilities for their apprentices in the widest possible sense. Education officers and apprentice supervisors have been appointed in considerable numbers and they take a keen interest in all aspects of the apprentice's work and social life. Nevertheless, it is certain that apprentices will not derive as much as they can from their period of apprenticeship unless the professional engineers on the staff will give time and thought to them. This does not necessarily mean giving formal lectures and so on ; it is much more important that the contacts and meetings should be informal. The youngsters should be given an occasional chance to meet senior engineers informally in the social club so that they can ask the numerous questions on all kinds of topics which are in their minds, and certainly much greater benefit will come from such contacts than would come from a formal lecture.

In developing the theme of co-operation and understanding between the professional man and the craftsman it will be profitable to consider briefly the importance of the part that the City and Guilds of London Institute has played for so many years. As long ago as 1876 a meeting of representatives of the Livery Companies of London was held at the Mansion House, and, as an outcome, the City and Guilds of London Institute was founded in 1880. Then, as now, the Institute concerned itself with technical education at all levels. In regard to craft education we owe much to their work and it would be impossible to over-estimate the important contribution in this field which has been made by the Institute during the last sixty years through its system of craftsmen's examinations, both technical and practical, and through its recognition of appropriate courses in technical colleges.

The repair certificate scheme sponsored by the late Institution of Automobile Engineers is worthy of mention at this stage because, at the time it was in operation prior to the 1939–45 war, it performed a valuable task in pointing the way to the recognition of craft skill in a broad field of mechanical engineering. Since the war this scheme has been replaced by one operated by the National Joint Industrial Council for the motor vehicle retail and repair trade and it is an example of how initiative on the part of a professional body set up a training scheme of direct value to all concerned.

Being primarily a steel man, I naturally turn to my own industry to ask how the craftsmen fare in it. Soon after the 1939–45 war the British Iron and Steel Federation set up a training committee. I was privileged to be a member for the first few years and although I am no longer on the committee I still follow its work with interest. Craft training for new entrants to the industry is given every attention, films, film strips, and lecture notes being in ample supply. The federation sponsors very successful foremen's courses, residential and non-residential, and " training within industry " for adults is encouraged. The value of these courses is much appreciated, as they deal with subjects such as job inspection, job relations, and job methods.

Before the end of 1953 there will be a new textbook published covering the City and Guilds iron and steel operatives course and that will be quite a step forward. Recently there was held a special course for craft instructors in the iron and steel industry at the Ministry of Labour's college, Letchworth, for instructors at Government training centres. Time does not permit me to deal further with this work, but it is apparent that the iron and steel industry throughout Britain is using every endeavour to maintain and improve craft skill amongst its many members, and by these means make a

contribution towards the improvement of the industry's productive capacity.

I would also like to refer to the work of the Sheffield section of the National Trades Technical Societies which aims at the improvement of the skill of craftsmen. The movement started in Sheffield towards the end of the 1914–18 war and has since spread to several other places. Its initiation was principally due to Professor William Ripper of Sheffield University, whose contributions to technology are well known. In 1918 many trades in Sheffield saw the difficulties of the approaching transitions from war to peace production. There were loud demands that production methods should be modernised, so that full advantage could be taken of foreign markets then favourable to Great Britain. The long traditions and highly individual characteristics of the Sheffield cutlery and tool trades made this problem one which could certainly not be solved by an ordinary commercial scheme nor by technical research. For example, did the application of modern methods mean some sacrifice of quality in order to make the goods cheap ? With so many highly skilled men in the trades, was there room for new methods involving the use of machinery ? Could science teach these men, wise in the way of their generation, anything which could profitably be combined with their deep-rooted experience ? These were the questions the correct answering of which was vital to the welfare of the local industries and their workers.

Professor Ripper tackled the problem. He had a great respect for the skill of the workmen and undoubtedly the workers held him in the very highest regard. He was wise enough to see that if he could combine the knowledge of the scientist with the experience of the craftsman he would be able to create a new and valuable factor in industry.

First of all, carefully selected lectures on modern methods, dealing with the cutlery, file, and tool trades were given with ample opportunity for question and discussion. Those lectures dealing with problems of reorganisation, standardisation and modern equipment created much interest and twice as many people came to enrol as could be accommodated. Because of the success of these initial lectures, Professor Ripper set about creating a movement which would represent equally the different sections of the Sheffield industrial structure : workmen, managers and employers. He planned to get all these groups, so diverse in outlook and interest, yet so dependent upon one another, to meet at the university. As an outcome immediate and decisive steps were taken to form trade technical societies for each industry.

The societies represented the complete internal structure of each industry and members of each section brought their knowledge and experience to the common pool. At that time managers, employers and workmen were sharply divided on many trade matters, and they were reluctant to combine for any purpose, so that this was a real triumph. Professor Ripper had wisely chosen an educational centre for the headquarters of the movement, and on that neutral ground it was easier for all concerned to sink their differences.

About 1938 the more strictly engineering section of our Sheffield industrial community formed its own technical society, and, of course, worked with some of the other societies concerned with the practice of engineering. In a very short time the section had a membership of 750, mostly workshop men. The council governing this section was equally representative of employers, management, and workers. The section grew to such an extent that later it was divided into engineering production, engineering maintenance, and electrical groups. To attend some of the discussions of these groups was quite an exhilarating experience. One heard the workshop point of view very emphatically expressed at times. Men of all ages attended, some seeking knowledge, others giving it, but all surely benefiting from hearing the different points of view and actual working experiences of fellow workers.

One would expect that from time to time papers should be presented to our Institution dealing with different aspects of the theme of my address this evening, and some important papers have been published in our *Proceedings* during recent years. You all know of the valuable work which our various specialist groups perform. The education group and the industrial administration and engineering production group have done good work in introducing subjects for discussion. In this connection I would like to underline some of the points which have emerged, and here are my notes on them :—

(1) Men who proceed straight into senior executive and administrative positions without sufficient practical workshop experience do not appreciate the need for craftsmanship in others.

(2) It is necessary to revive pride in skill for skill's sake.

(3) Great Britain could not hope to compete with the United States in the world's markets with mass-produced articles designed to have a limited life. Britain should concentrate on the higher grade products made to last and which usually require a higher degree of skill in manufacture.

(4) Craftsmen, as a class, are of paramount importance to any industry and should enjoy at least the same prestige as a design draughtsman.

(5) The basis of successful management is an understanding of human relationships.

The suggestion was made in one of the papers referred to that the Institution should do something further to promote good craftsmanship. Whilst I do not think the Institution bears a specific responsibility in this connection, there is no doubt that individual members can do a very great deal through their personal influence. Craftsmanship is primarily a function of the workshop.

I should like to press for a still closer association between the training establishments and the workshops ; the relationship between educationalists and industrialists is undoubtedly improving, but there is still some room for even closer understanding of the common problems. Many well-known firms have a remarkable record for co-operating in this way and such firms are most generous in the facilities they make available for technical college and university students to gain practical experience. The training of the future leaders of industry is a responsibility which more and more industrialists are coming to accept gladly. I could wish that there were more opportunities for lecturers and teachers of engineering subjects to have closer direct touch with industry and it would be especially helpful if periodically they could work on actual production problems in the workshop alongside craftsmen against " time " and " cost." Progressive local education authorities allow leave of absence to this end.

Two Novel Fendering Systems

The hydraulic fenders recently installed at the new Car Ferry Terminal at Dover are described hereunder. Details are also given of the design for a hydraulic-pneumatic fendering gear proposed to solve the problem of resisting berthing blows not only at right angles to a quay, but over a wide angle of impacts.

THE problem of absorbing the energy of a blow caused by a berthing ship, is one which has exercised the minds of engineers a great deal in recent years. Various trends, such as the use of larger ships or of relatively slender piled jetty systems have accentuated the need for effective systems of fenders, capable of resisting blows from heavy ships, and numerous new designs for fendering systems have been introduced in post-war harbour and jetty works. One such design, which utilises a hydraulic buffer to resist the blow from the ship and to absorb some of the energy of that blow, has been installed at the new car ferry terminal at Dover Harbour, which was officially opened last June.*

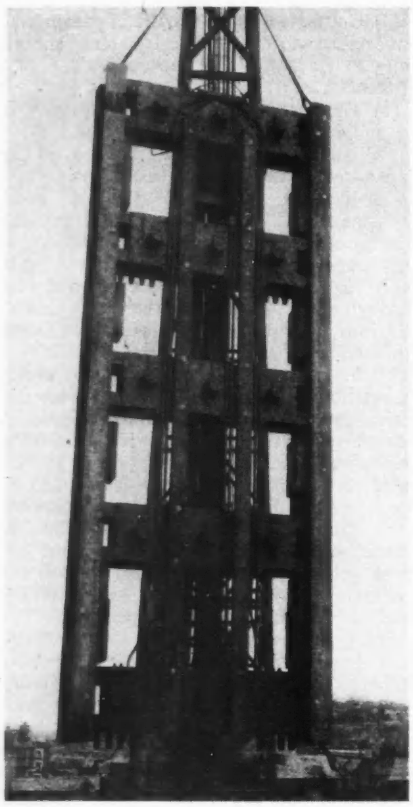
Two loading berths are provided at the terminal, arranged for stern loading of the car ferries. Thus a portal frame carrying a hinged landing bridge faces the stern of the vessel in the berth. The fender system is installed at this point to take any blows which may be experienced from the stern of the ferry as it berths. The terminal is intended for ships up to about 400ft in length and 70ft beam, and is used over a range of tides of 18ft 9in (L.W.O.S.T. to H.W.O.S.T.), so that the fenders have been designed to function over that range.

The fenders consist of four units, two installed in each of the berths. The steelwork for each of these units—a frame about 31ft long by 11ft wide and 20in deep—was designed by the Dover Harbour Board, but the hydraulic buffers themselves were supplied by George Turton Platts and Co., Ltd., of Sheffield, which firm was responsible for the development of this system of fendering.

Fifteen 6in stroke buffers are built into each fender unit, which is constructed of heavy rolled steel sections so as to form a rigid steel mattress ; the mattress is suspended from anchorages built into the berth walls. Fender timbers are bolted to the outer frame of the mattress so as to prevent metal contact with ships when berthing, and the rear of the fender is faced with timber to limit the working stroke of the buffers to 5in. The design provides for vessels up to 3000 tons berthing stern on at a speed of 2ft per second on the two fenders, which are shown in position under the portal of the berth in one of the illustrations overleaf. The first illustration shows one of the units being hoisted into position, and the fifteen hydraulic buffers may be clearly seen. Consideration was given in the design to the fact that vessels berth at different levels according to the state of the tide and that the beltings employed on the several vessels using the berths vary considerably, and the design provides for six buffers absorbing energy of the order of 2200 inch-tons at any one time.

The makers point out that the effectiveness of a buffer should be considered by its energy absorbing capacity, always providing it is sensitive to light as well as heavy impacts, and that hydraulic buffers provide these features because they are speed sensitive and have substantially constant stroke at all speeds up to a speed where a shock wave occurs due to resistance of the fluid flowing through the discharge orifice. The discharge orifice must therefore be designed to suit the maximum speed which is likely to be encountered in each particular application.

* It is not without interest to compare this design with the aeronautical applications of much the same principle to undercarriage design which were described in THE ENGINEER of August 21st to September 18th last.

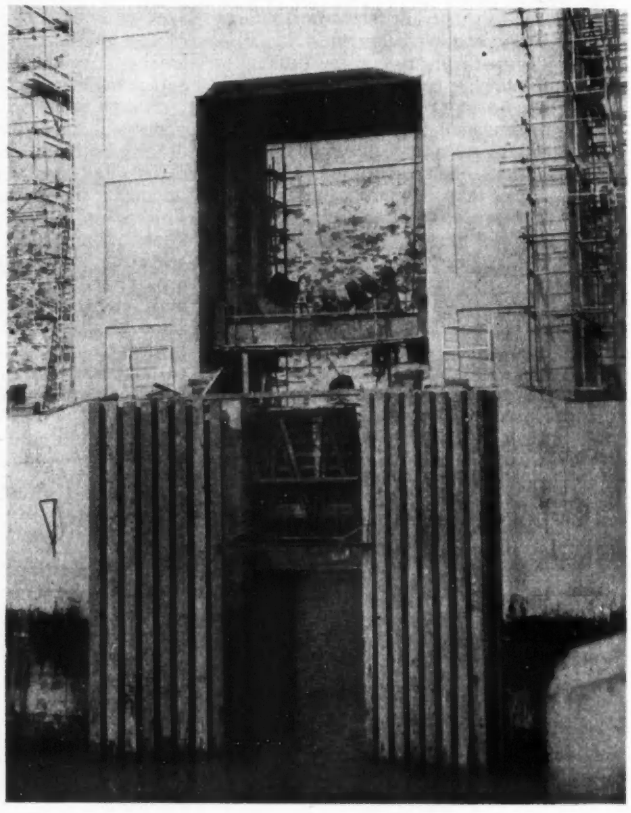


Installation of Fender Unit at Dover Car Ferry Berth

The cross-sectional drawing on page 521 shows one of the hydraulic buffers of the fender units at Dover. The variable orifice flutes in the throttle stem which passes through piston head, form the discharge orifice from the buffer cylinder to the expansion chamber in the ram. It will be appreciated that the higher the speed when forcing the plunger inwards, the greater will be the energy absorbed in discharging the hydraulic oil through the diminishing orifice. Furthermore, if the pressure control vessel is charged with air and the volume change in it due to the displacement of oil during buffing is such that the final load reaches a value of 1 ton, then a dead load of 1 ton, or slightly more, to allow for friction, will compress the buffer to the full extent of its stroke, but the time would be considerable and the energy absorption negligible. Thus it will be seen that the final load under static conditions bears no relation to the energy absorption under dynamic conditions.

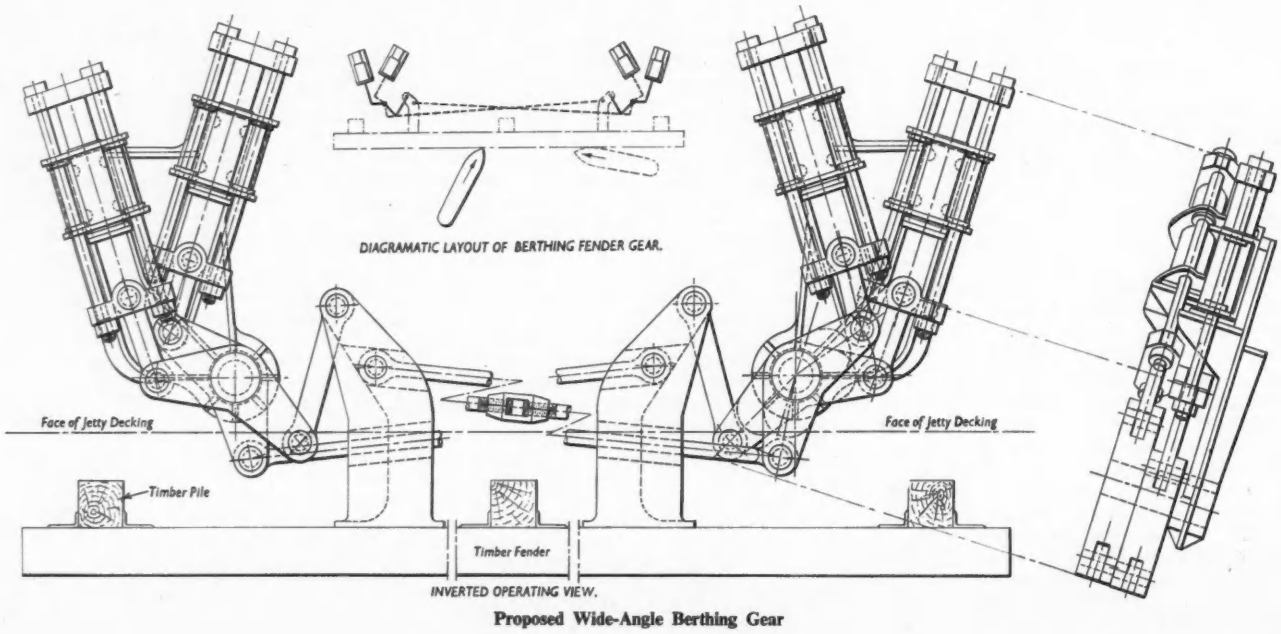
The construction of the buffer is straightforward, the makers state, but it incorporates several refinements suited to this particular application. The annulus at the rear of the piston head, for instance, is connected by ports to the expansion chamber in the ram and provides relief of the high pressure generated when buffing and so prevents excessive pressure on the piston seals. The piston seals are toroidal synthetic rubber rings housed in phenol formaldehyde plastic piston rings. Exclusion of seawater is effected by similar seals, both static and slidable, the purpose of the latter being to retain lubricant "gunned" in from a remote point.

The assembly may be serviced or the pressures checked irrespective of tidal conditions, even when the buffers are submerged. The five buffers in each of the three vertical rows of the unit are connected to a hydraulic manifold pipe leading to the control vessel situated between the top two frames of the unit. The control vessel, as we have already indicated, encloses air under pressure above the hydraulic fluid. Small bore oil and air pipes from the control vessels are carried through the top frame to service valves mounted on a battery plate stand at the top of the fender. There are also nipples and connections on the battery plate to each buffer for lubrication of the water-excluding seals. All the pipes are protected against damage from floating objects in the final assembly.

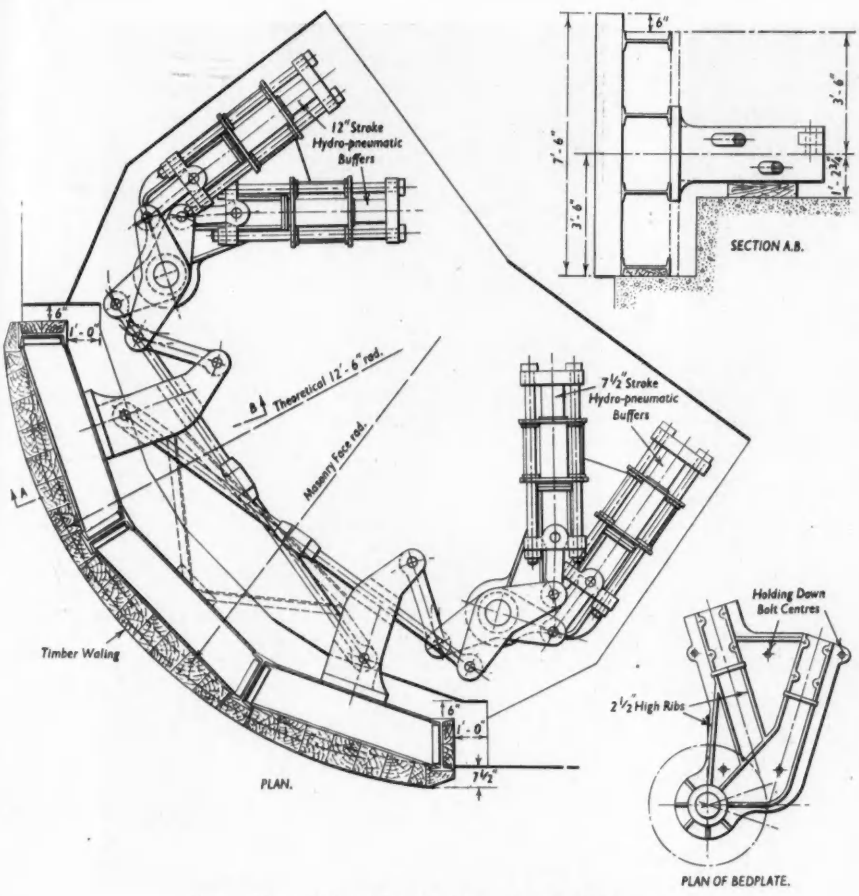


Fendering at Car Ferry Berth at Dover

Our second illustration on page 521 shows diagrammatically the construction of a self-contained hydraulic-pneumatic buffer. It is speed sensitive and its energy absorption capacity is automatically variable relative to the weight and speed of the impacting mass, but being provided with a pneumatic cushion between the buffer head and the hydraulic fluid in the cylinder, higher speed impacts can be accommodated than with pure hydraulic buffers. The function of the pneumatic cushion is to eliminate initial shocks of impacts and to dampen out hydraulic shock waves when the buffer is resisting the greatest impacts. The air cushion also makes the hydraulic buffer less sensitive to mass and speed change, thus favouring its use in applications calling for a wide range of duty by preventing excessive loads in the early part of the stroke incurred with light high-speed masses and without



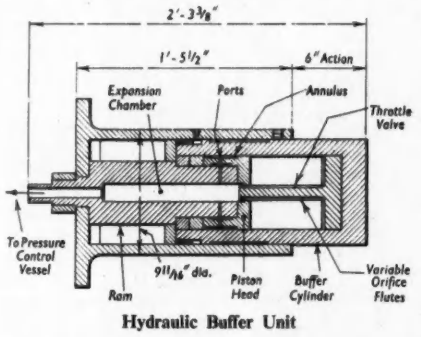
Proposed Wide-Angle Berthing Gear



Proposed Layout for Cushioning Fender for Dock Entrance

affecting its capacity to absorb the energy of heavy slow-moving masses.

In a self-contained buffer, the air used for recoil, being compressed to a higher ratio, absorbs a larger percentage of the energy than in the grouped buffer system previously mentioned. For example, the hydraulic-pneumatic buffer illustrated can be designed so that at low



Hydraulic Buffer Unit

speed, say, 6in per second compression speed, the hydraulic energy absorption will be 80in tons and the pneumatic absorption 80 inch-tons, but at 24in per second the hydraulic energy absorption would be 1280 inch-tons, whilst the pneumatic section would remain at 80 inch-tons. In the case of a grouped system for similar duty,

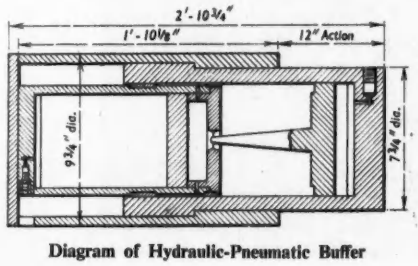


Diagram of Hydraulic-Pneumatic Buffer

the figures would be 80+20 inch-tons at low speed and 1200+20 inch-tons at the higher speed.

Proposed Wide-Angle Berthing Gear

The self-contained hydraulic-pneumatic buffer has been utilised by George Turton Platts and Co., Ltd., in the design for a wide-angle berthing gear. Berthing fenders of both framed and pile construction normally provide for broadside or near right-angle impacts; but in very many cases they are guided or supported to prevent lateral movement and do not cater for the more prevalent heavy glancing blows which cause much damage to berths and the hulls of ships. The proposed wide-angle berthing gear was therefore designed to absorb the energy of glancing and angular impacts and to enable the fender system to ride with the vessel for a limited distance.

Two forms of the gear are shown in the illustrations. It consists essentially of a double unit comprising two pairs of high-capacity buffers mounted on a rigid steel bed-plate to which is also fixed a large diameter pivot pin carrying two heavy levers. Each unit is connected by links to two separate yokes mounted on a common fender beam which, in turn, is secured to the fender piles. Movement of the fender beam and piles within an included angle of 180 deg. is resisted by the buffers, and the maximum movement is limited to the actual stroke of the buffers. The linkage is arranged for one buffer in each unit to absorb the energy of broadside-on berthing impacts and the other buffer in each unit to absorb the energy of glancing blows or impacts at any angle to the face of the berth in either direction. The buffers operate independently or conjointly relative to the angle and point of contact, and as each unit is separately mounted the spacing of the units may be arranged to suit the length of the fender beam and the number of piles to be covered. The only modification required is that of the long connecting-rods connecting each separate unit to the opposite yoke. The levers, connecting-rods and pivot pins are arranged to maintain a straight line piston-like motion in the buffers in order to avoid excessive wear, and also to operate in tension and so eliminate compression or bending stresses.

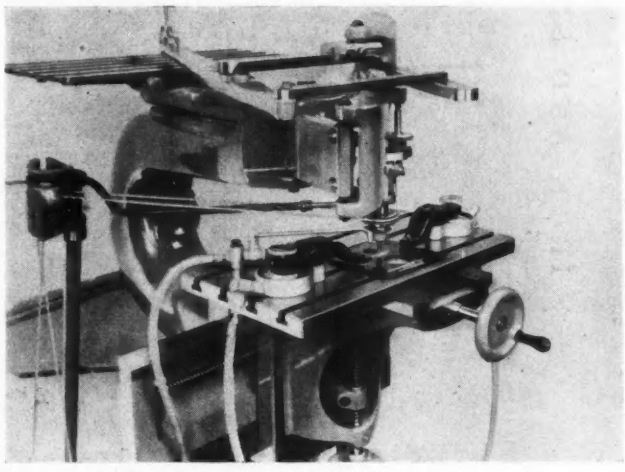
The energy absorption capacity of the gear is variable depending upon the size and number of buffers employed, but as an example, two buffers each of 10in effective stroke and 100 inch-tons per inch of stroke capacity and two buffers stroking only 2½in would arrest direct or nearly direct-on impacts up to 2032 inch-tons. For acute angle impacts, however, only one buffer comes into complete action with about 2in stroke of its adjacent buffer, therefore the maximum energy that could be absorbed in such an occurrence would be 1008 inch-tons. This energy would be supplemented by the potential energy in the fender piles secured to the fender beam.

Another illustration shows the principle of the wide angle gear applied to fenders for the knuckles or round heads of dock entrance channels. Such a fender could be positioned so as to give at full inward stroke the full width of the entrance, at the same time riding with the vessel.

A Pneumatic Clamping Unit

THE industrial pneumatic equipment now being made by the Baldwin Instrument Company, Ltd., Brooklands Works, Dartford, Kent, includes a clamp for use in holding piece parts during machining. This unit is at present made with two types of clamping arm—one for accommodating work up to ¼in thick and the other for work up to 3in thick.

The equipment consists of a compressed air control valve, which operates a number of clamping units. Each clamping unit has a compact single-acting air cylinder with a short stroke



Clamping Unit In Use

and operating in combination with a suitable lever system to press the clamping arm down on to the work. As can be seen from the illustration of a pair of the clamping units in use on an engraving machine, they occupy a space well clear of the work.

With a working air supply of 80 lb per square inch the clamping force exerted at the toe of the clamping arm is stated to be 170 lb. The toe has a rubber covered face, and its position is adjusted by a knurled knob to suit the thickness of the component being handled.

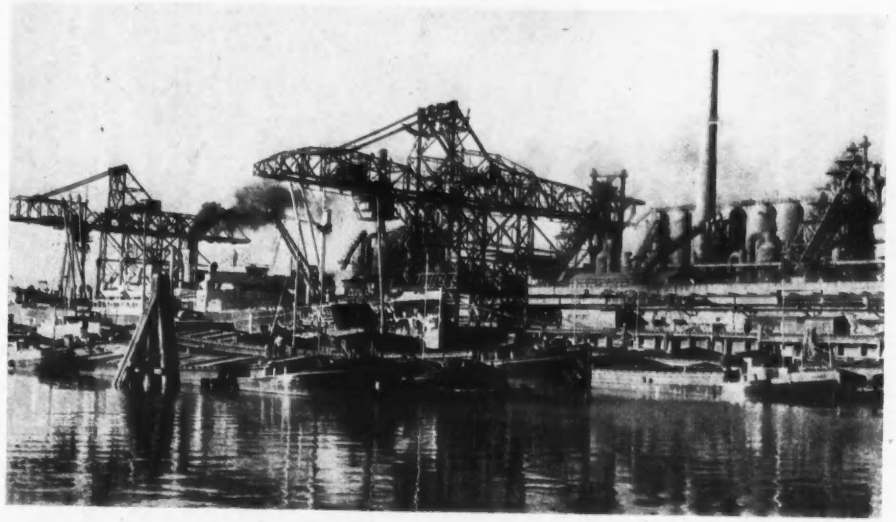


Fig. 5—Ijmuiden—Sea Port and Blast Furnaces

Fig. 6—Slabbing and Blooming Mill

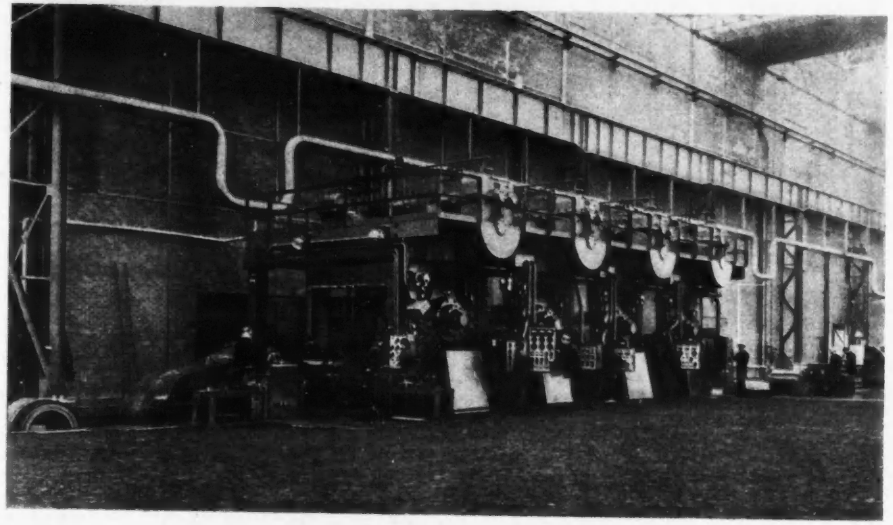


Fig. 7—Continuous Four-Stand Cold Reduction Mill

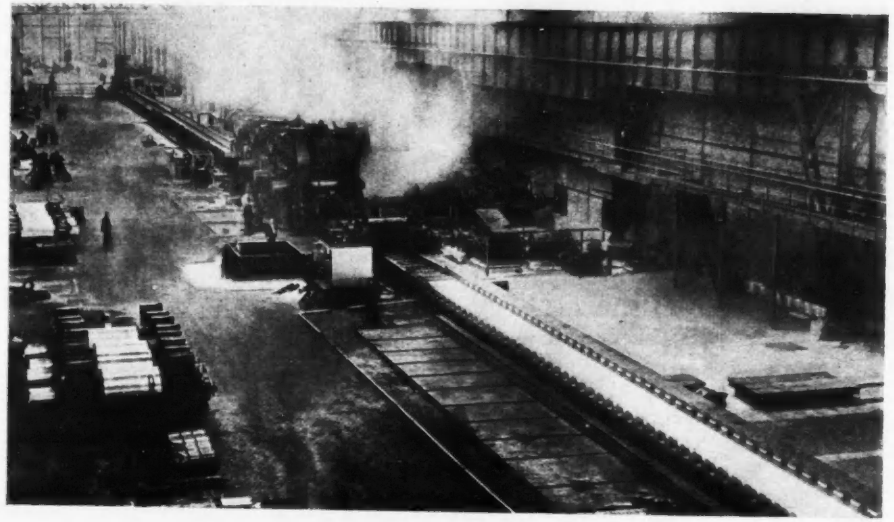


Fig. 8—Semi-continuous Hot Strip Mill

Iron and Steel Institute in Holland

No. II—(*Continued from page 500, Oct. 16th*)

From September 30th to October 7th the members of the Iron and Steel Institute paid a visit to Holland. Their activities are described and mention is made of a number of the works they visited.

EARLY in the last century, when Britain was becoming the "workshop of the world," a number of Englishmen and Scotsmen left this country and either by themselves or in partnership with nationals of the countries concerned, set up engineering establishments on the Continent, several of which have since grown into some of the largest and best-known firms in the world. One of the firms visited by some members of the Iron and Steel Institute, including ourselves, on the first day of the meeting in Holland, was Werkspoor N.V. of Amsterdam. This firm was not, indeed, founded by an Englishman. Its founder was Paul van Vlissingen, who, in 1827, rented a single building of the former East India Company, close to Amsterdam harbour and started a forge and repair shop for marine engines. But its founder seems immediately to have called into his service a number of Englishmen to start it going. Since then, as every engineer knows, the activities of the firm have grown widely; to such an extent, indeed, that it is now engaged in almost every engineering field. Besides the marine and traction diesel engines for which, perhaps, the firm is best-known in this country, it produces steam engines of all types marine steam turbines, shell and water-tube boilers, compressor plant, pumping plant, refrigerating machinery, steam, diesel and electric locomotives, and railway rolling stock. In addition it is interested in constructional steelwork, having built many of the very numerous bridges required in a country heavily interspersed with canals, has been and is engaged in the manufacture of equipment for the sugar cane, sugar beet and palm-oil industries, and has entered the fields of chemical and oil engineering, for the latter of which fractionating columns and cracking installations are made.

It may well be imagined that the area covered by the works at Amsterdam has continually expanded! They now cover 33·6 acres and concentrate more particularly on the manufacture of engines and marine equipments. A newer works at Utrecht, with an area of 74 acres, which was not visited by members of the Institute, has taken over the railway and road transport activities and the constructional engineering side.

Unfortunately, as so often happens when a visit to a single firm has to conform to the time-table of a complete meeting, the time allowed—a single morning—was quite inadequate for the members who visited this firm to gain more than a very broad conception of the work being undertaken and of the high standard of quality maintained. Many things of interest were seen. But lack of time did not permit discussion of them. We prefer, therefore, to leave a fuller description of these works to a later occasion. But we illustrate in Figs. 9 and 10 a machine shop and the turbine blading section of the Amsterdam works.

Other parties of members visited the Amsterdamsche Droogdok - Maatschappij N.V., which besides repairing ships also builds them and constructs engines and boilers; the Nederlandsche Doken Scheepsboumaatschappij which is similarly employed and Asscher's Diamond factory.

Official Reception

The official reception of the members of the Institute took place the same afternoon. Mr. A. H. Ingen Housz, President van de Directie der Koninklijke Nederlandsche Hoogovens en Staalfabrieken N.V., chairman of the Reception Committee, remarked how happy they were in Holland to welcome the members of so great an Institute to their small industry and expressed a special welcome on behalf of his own company. In reply, Mr. James Mitchell, President of the Institute, said he felt safe in prophesying that the members would have a very good time (a prophecy amply borne out by subsequent events), that they would be able to renew acquaintances already made and make many new ones. As to the small scale of the Dutch industry it was not scale that mattered but the efficiency with which the work was carried on. He announced that Mr. Ingen Housz had been made an honorary vice-president of the Institute.

It had been planned that a lecture on "Research and Development in the Iron and Steel Industry in the Netherlands"

Fig. 9—Werkspoor Machine Shop

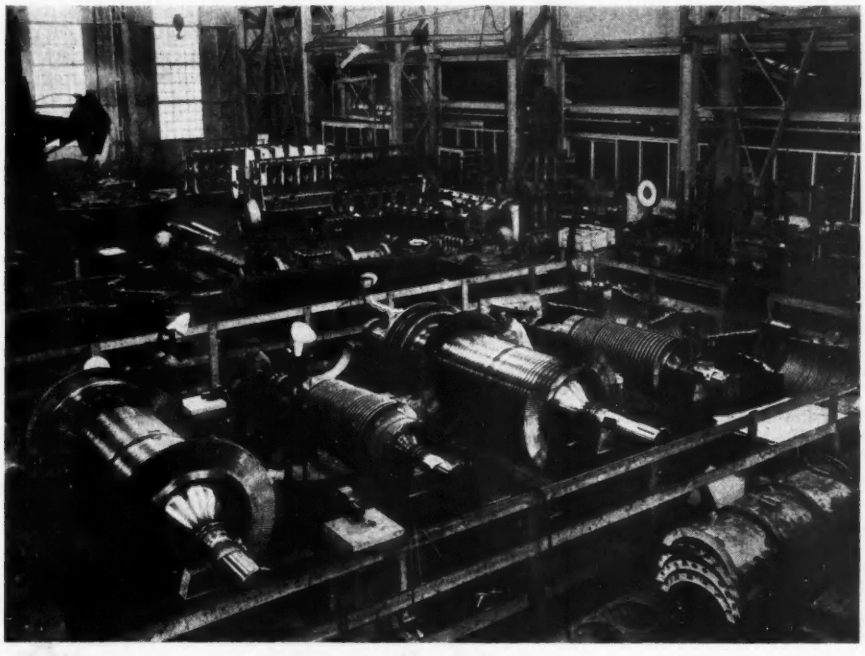


Fig. 10—Blading Turbine Rotors

should be next presented by Professor J. E. de Graaf. Owing to illness, however, he was unable to attend the meeting. In his place Ir. G. W. Stein Callonfels, who is in charge of the experimental department at the Ijmuiden steel works, read a paper on "Flame Radiation in Furnaces." It dealt with the programme of research being carried out by the International Flame Radiation Research Joint Committee at the Ijmuiden works and more particularly with the new research furnace that has just been completed and which is now being equipped with instruments at these works and which the members were able to inspect on the following day. The work of that organisation was described in our issue of June 20, 1952. A film, "The Great Jib," was next shown. It illustrates the construction of the great tubular steel jib fitted to the "W1400" walking dragline built by Ransomes and Rapier, Ltd., for Stewarts and Lloyds, Ltd., of Corby, which was described in our issue of November 2, 1951.

In the evening there was a reception by invitation of the Lord Mayor of Amsterdam at the Stedelijk Museum. This museum contains, amongst others, many works of nineteenth century and early twentieth century painters and sculptors and also many contemporary works. Members found many of the latter somewhat indigestible and difficult to interpret!

Ijmuiden

On the following day, Friday, October 2nd, members paid a visit by special train to the steel works of the Royal Netherlands Blast Furnaces and Steelworks, Ltd., at Ijmuiden, at the North Sea end of the Nord Zee Canal. This works was originally started soon after the first world war. The company's first furnace was blown in during 1924, the second in 1926 and the third in 1929. These furnaces each produce 600 tons a day, of which about one-third is used as hot metal by the melting shop and two-thirds are cast into pigs in a modern pig casting machine. Materials are brought to the site by water and an engraving (Fig. 5), on page 522, shows part of the harbour which has facilities upon both sides of the great lock gates of the canal so that sea-going vessels bringing oversea ore can moor in the outer harbour and barges (as well as sea-going ships) can tie up in the other, bringing, for example, coal from Limburg. Four batteries of coke ovens convert the coal. Much of the gas produced is piped off for the use of neighbouring municipalities and a pipeline is to be constructed as far as Amsterdam. Some of it is treated in the plant of a nearby affiliated company for the manufacture of artificial fertilisers.

The melting shop has been designed especially for the production of ingots for rolling purposes. There are five oil-fired open-hearth furnaces, each of 200 tons capacity, the first of which started operations in 1938. The ingots are top-teemed and taken on bogies when still hot to a separate stripping bay, whence they are placed in soaking pits. The slabbing/blooming mill illustrated in Fig. 6, which operates on these ingots, has a capacity of 600,000 tons of ingots a year. It started work in April, 1952. Its design was influenced by the fact that it supplies two sets of mills and by the desire to keep investment expenditure low without ruling out further extensions. It provides material for the Royal Netherlands Company's plate mill, which is capable of rolling some 250,000 tons a year of heavy plate for shipbuilding and structural purposes. It also supplies slabs to the new hot strip mill of a private company, Breedband N.V., which adjoins the steel works. The latter mill at present requires a slab width of 52in. But when the hot mill is enlarged by two more stands, as is planned, heavier slabs will be needed and ingots of 15 metric tons instead of the present 11 metric tons in weight will have to be handled.

Particular interest was shown by the members of the Institute in the new Breedband N.V. mills erected since the war in a very fine new building. For it is completely modern, having started work only a year ago and here is a plant designed for the economical production of a relatively modest output of strip and tinplate. It has very recently been fully described elsewhere.* There is a four-high, four-stand, tandem hot-strip mill preceded by a reversing roughing stand—Fig. 7; and after being coiled the hot rolled strip is either squared into sheets or pickled in a continuous pickling line for further cold rolling. Cold rolling is performed in the four-high, four-stand tandem mill illustrated in Fig. 8. The output of the mill consists as to about one-third of hot rolled strip sold as squared sheet and to about another third of cold rolled strip or sheet. The remainder is sheared to tinplate requirements and tinned by the hot-dip process. There is a battery of eight hot-dip tinning machines, each with a capacity of 10,000 tons of tinplate a year.

Tea was taken in the very fine modern canteen of the works. The firm makes a practice here of exhibiting the works of Dutch artists where their workers can see them. But at the time of the Institute's visit a special collection of works of Vincent van Gogh was on show.

In the evening there was a "social evening" with supper and dancing at the Grand Hotel Krasnapolsky, by invitation of the Nederlandsche Yser en Staalindustrie.

(To be continued)

The Development of Broadcasting in Great Britain

INSTITUTION OF ELECTRICAL ENGINEERS' INAUGURAL ADDRESS

No. II—(*Concluded from page 487, October 16th*)

The inaugural address of Mr. Harold Bishop† as president of the Institution of Electrical Engineers was delivered in London on Thursday, October 8, 1953. Mr. Bishop's address was mainly concerned with the development of the broadcasting service (including television) in this country. Abstracts from the address are reproduced herewith.

Television Broadcasting

System Standards.—The system standards adopted for the pre-war transmissions were 405 lines, 50 frames, interlaced. There were some 20,000 television receivers in the hands of the public when the service closed down at the beginning of the war in September, 1939.

In 1943 the Government set up a committee under the chairmanship of Lord Hankey to prepare plans for the reinstatement and development of the television service after the war. The B.B.C. were represented on the committee, and supported its recommendations. It was generally agreed, not only that the pre-war standards were capable of giving satisfactory results in the home, but that there would be a long delay, of perhaps several years, before an alternative system could be developed and made available for public service. The television service was therefore reopened with the pre-war standards on June 6, 1946.

In the light of developments since that time there is no doubt that this was the right decision. It would have been undesirable and unnecessary to delay the reopening until an improved system had been developed and brought into service. In the past seven years great improvements have been made in picture quality by the development of improved camera tubes, by better use of the available bandwidth, and by the development of improved receivers. A system employing a greater number of lines would have needed a wider bandwidth to convey the information and would have required more channels for national coverage than are available in the band 41–68 Mc/s. Incidentally, all pre-war receivers would have been made unserviceable without considerable change, and it would have been more expensive to distribute the programme by line or radio link.

It is of interest to mention that, if in a television system there is one link which is not designed to pass the full bandwidth required by the system, then the quality of the picture is better if the bandwidth required by the signal is reduced to the bandwidth which the link will pass. In a practical case, if the picture has to pass over a line link with a bandwidth restricted to, say, 2·8 Mc/s, better picture quality is obtainable from a 405-line 50-frame interlaced system than can be given by a 625-line 50-frame interlaced system. Tests have proved the correctness of this statement, and it is worth remembering that television links in Europe are likely to be designed, for economic reasons, to have a pass-band not exceeding 2·8 Mc/s.

Extensions to the Service.—The B.B.C.'s first task on reopening the service was to make plans for extensions to other parts of the country. Four transmitters of 100kW e.r.p. (effective radiated power) have now been erected in the Midlands, the North, Scotland and South Wales, and with the London transmitter at Alexandra Palace the five stations serve 40,000,000 people, a coverage figure of 80 per cent, which is substantially greater than has been achieved so far by any other country. In 1949 plans were prepared for five medium-power stations which would increase the coverage to about 95 per cent. Because of restrictions on capital investment, Government permission to begin the construction of these stations was withheld, but towards the end of 1952 the Government allowed temporary stations near Newcastle, Belfast and Brighton to be built in time for the Coronation. The Government have now agreed that the construction of the five permanent medium-power stations near Newcastle, Belfast, Plymouth, Aberdeen and in the Isle of Wight may be put in hand, and in addition low-power stations in the Isle of Man and the Channel Islands. This work is now in progress.

The B.B.C. also have in hand the rebuilding of the London station with higher power on

* *Iron and Coal Trades Review*, September 18, 1953, page 627.

† Director of Technical Services, British Broadcasting Corporation.

the site of the Crystal Palace in South London. The Alexandra Palace station was designed in 1935 and in many respects it is now out of date. The new station will ultimately have a power of 500kW e.r.p., the maximum allowed under the Stockholm plan. The vertically polarised aerial will be erected at the top of a self-supporting steel mast 640ft high. The higher power of this station will not greatly increase the area already served by Alexandra Palace, but it will give a much stronger and therefore more interference-free signal in those parts of London and the suburbs where the level of interference is high. Moreover, it will greatly improve the service along the South Coast, at present a fringe area where reception generally speaking is unreliable.

These extensions will be well on the way to completion by the end of 1955. To give service to the remaining 5 per cent of the population the B.B.C. plans to build six more low-power stations to fill in the unserved areas and raise the coverage figure to about 98 per cent.

Frequency Bands.—The Government have come to the conclusion that, in the expanding field of television, provision should be made to permit some element of competition when the calls on capital resources make this feasible. If this plan is to be implemented one of the problems which will need most careful consideration is how the frequency channels available for television are to be allocated to the various claimants.

In October, 1952, the Postmaster-General appointed a Television Advisory Committee to advise him on the development of television and sound broadcasting at frequencies above 30 Mc/s. By international agreement three v.h.f. and two u.h.f. bands have been assigned to television and sound broadcasting. For convenience they are referred to as Bands I–V ; their ranges are as follows :—

	Mc/s	
Band I	41–68	V.H.F.
Band II...	87·5–100	V.H.F.
Band III	174–216	V.H.F.
Band IV	470–585	U.H.F.
Band V...	610–960	U.H.F.

For the system standards in use in this country a bandwidth of 5 Mc/s is necessary for each television channel. The five channels in Band I are occupied by the five existing high-power transmitters. The five medium-power transmitters under construction and certain low-power transmitters will also use these channels. Band II, of which only about one-half is available for broadcasting, will be wanted for v.h.f. sound services. A large part of Band III has also been allocated to services other than broadcasting, and only a part of it—sufficient for two television channels—can be made readily available for television.

In consequence, attention has been turned to Bands IV and V, where there is space for ninety-three 5-Mc/s channels. Unfortunately the service areas of transmitters operating in these bands will be appreciably restricted as compared with what can be achieved on Band I, for two main reasons :

(*a*) The higher field strength required for satisfactory reception, and

(*b*) The greatly increased effect of ground contour.

Transmitters in Bands IV and V are not likely, even in favourable circumstances, to have a range exceeding 40 miles. Increase in power within foreseeable limits will not appreciably increase this range, although higher power will tend to improve the quality of the picture within the service area.

Many more transmitters, probably at least double the number, will be wanted to give national coverage on Bands IV and V than are wanted on Band I. Difficulties will be most acute in hilly countries, where the screening effect of large hills inside the nominal service area of the transmitter may mean that only a proportion of potential viewers in a given area will be served.

There has not been sufficient experimental work on this subject, and until more evidence is available to confirm and supplement existing propagation data as applied to geographical and social conditions existing in this country it will be difficult to assess the overall value of Bands IV and V for public television service.

Automatic Equipment.—To the operator of a television service one of the serious problems is the cost of staffing television studios, control rooms and outside broadcast units. It is in this direction that we look for reductions in the cost of television operations. For example, in a television studio in which, say, a simple play is being produced, about eleven engineers and technicians are needed in the studio itself and nine others in the control and apparatus rooms. There would be at least as many non-technical staff and many more manual staff. Moreover, the load factor of most of these people is very low ; they are all busy for part of the time, but for long periods they have little to do.

It is clear, therefore, that one way of reducing the overwhelming costs of television production is by the development of equipment which is automatic or semi-automatic in operation and can be controlled remotely. It cannot necessarily be simplified—indeed, the tendency is in the other direction—but it can be made to operate far more cheaply by requiring fewer manual operations. Here then is a most fruitful field for the designer of all types of television equipment. In the sound broadcasting field the B.B.C. has led the way in the development of staff-saving equipment, and in the past few years has saved over 300 posts by its use. The operation of sound transmitters up to 150kW output without supervisory staff is now a common arrangement, switching operations, control and monitoring being entirely automatic. It is to be hoped that television installations will develop on similar lines.

Colour Television

The problem is to provide a colour picture which may be received in the home on equipment reasonable in cost and size and reliable in operation. Moreover, it is obvious that if a colour system is to be introduced it is essential that the very large number of black and white receivers already in the hands of the public should be able to continue to receive a picture in black and white. Here there are two technical terms which need defining. A compatible colour system is one in which an existing monochrome receiver can, without modification, reproduce a black and white picture from the same transmission as will produce a colour picture on a suitable receiver. A non-compatible colour system is one in which an existing monochrome receiver cannot reproduce a black and white picture from the colour transmission.

Broadly speaking, it can be said that in a compatible system the luminance or brightness components of the colour picture must be transmitted in the same bandwidth, on the same standards and on the same channel as would be used for a monochrome picture. If the chrominance or colour components are also transmitted in the same bandwidth, the system is usually described as fully compatible, but the advantage of a compatible system is not lost if these components are transmitted outside but adjoining the monochrome bandwidth. This would be possible only if sufficient adjacent channel space were reserved for the purpose. If the colour transmission system required a considerable increase in bandwidth as compared with that required for a black and white picture, the proposal would have to be studied in relation to the bandwidth available for television transmission as a whole.

Full compatibility may not be achieved on British standards in a form acceptable for public service. If the alternative is a compatible system with the chrominance information located outside the monochrome band, it will not be possible to fit the system into Band I, at present fully used for television. In this case colour must go to one or other of Bands III, IV and V.

In any colour system it is desirable that the additional equipment needed as compared with a monochrome system should be as far as possible at the transmitting end in order that the receiver may be kept simple and cheap. Indeed, the assessment of the value of a colour system must take careful account of the type of receiver required.

It is generally agreed in television that the signal transmitted need not give more than is necessary to ensure pleasing reproduction. This criterion for a monochrome picture will apply with more force to a colour picture because of the need to meet the requirement of compatibility and because to send more than the minimum amount of information is expensive in bandwidth and cost, both in the transmitting chain and in the receiver. It follows, therefore, that, if possible, colour television should be achieved within the present monochrome channel width of 5 Mc/s, of which 3 Mc/s are used for the video band. Now, the whole of this video band is normally required for the transmission of a monochrome picture, and to transmit full definition in three colours it would seem necessary to have three times this bandwidth. The problem is therefore to devise a system which reconciles these conflicting requirements.

Experiments show that at picture brightness likely to be used for normal home viewing, there is no noticeable deterioration of the picture if less detail is transmitted in the blue than in the green and red. This points the way to a means of saving bandwidth, but the vital problem is how further saving can be achieved so that the transmission can be kept within 3 Mc/s.

A great deal of work has been done on this problem, particularly in the United States. It is obvious that pictures in each of the three separate colours may be transmitted sequentially or simultaneously, or by a combination of these two methods. What is important is that the eye must not perceive alternation of colour images.

Only a very small part of the monochrome bandwidth can be used for the transmission of the chrominance information if damage to the quality of the monochrome picture is to be avoided. With great ingenuity American research workers have devised a fully compatible system on American standards, and the suitability of this system for public service is at present under examination by the Federal Communications Commission.

A decision on the system to be used in this country will depend on the progress of research work and on field tests. Colour will undoubtedly come, but it may be some years before it is a serious competitor to monochrome.

The second problem is the development of a colour camera. One solution is to use three camera tubes, each dealing with a primary colour, combined into one camera. Such an arrangement, although elaborate

and costly, has already been developed; its setting up and operation is a highly skilled job, but this would be under the control of skilled staff in the studio.

The third problem is the method by which the radio signals can be reconverted at the receiving end into a colour picture. At present it is fair to say that this is a most difficult problem. In America at least two methods have been developed. In one, the R.C.A. tri-colour tube, the screen consists of a very large number of dots in groups of three, each capable of delivering one of the primary colours. The incoming signal energises the appropriate dots at the appropriate time and a colour picture is produced on the tube. In another, the Lawrence tube, the three-colour fluorescent material is in strips instead of dots. It is, I think, too soon to say whether these devices or some other method yet to be developed will form the basis of the colour receiver of the future.

These remarks on colour television do no more than touch on some of the problems confronting the manufacturers and the television operators which must be solved before this new medium can become available for public service. The problems are financial as well as technical, and I think it will be some years before they are fully solved. So far as this country is concerned, there is likely to be strong pressure, not only for the completion of the present television coverage, but also for alternative programmes in monochrome, before colour television is introduced.

The Institution and the Industry

I would like to conclude my address with a few comments on recruitment and training, subjects which have been so frequently discussed of late that some may think that it is time we did more and talked less. I agree, but, in fact, a great deal is being done and future action is worth discussing.

I suggest that our first duty is to establish more clearly in the public mind what a trained professional engineer does, how he is trained, and in what ways the title "engineer" may be properly applied. Until that at least has been done we cannot hope to attract into an engineering career a sufficient number of boys with the right type of training and character.

What steps should we take to put this right? First of all, we must make a realistic attempt to assess our needs. We must decide how the number in our industry and profession is likely to vary in the coming years, and what effect this will have on the number of school leavers that should enter engineering. I believe that the last attempt to assess demands for professionally qualified staff in the engineering profession was in the 1948 Report of the Electrical Engineering Panel of the Engineering Sub-Committee of Lord Hankey's Technical Personnel Committee. I suggest that the figures in this report may now be out of date and that there is an urgent task of revision which should have the Institution's close study in association with industry. Nothing would be more unwise than to stimulate a wider interest amongst young men than we as a profession can support. When we are sure of our facts we shall be better equipped to get what we want.

The next step is to see that the headmasters and careers masters of the public schools and grammar schools have a clear idea of how a boy may be trained as an engineer. The lack of information in schools about engineering is surprising and disturbing. The majority of boys at school may study science, pure and applied, but are hazy about its connections with engineering. We want to encourage more schools to have engineering sides teaching subjects in preparation for an engineering career. Too often are science subjects thought to be preparation only for careers in pure science.

I read recently that last year 482 science students graduated with honours from Oxford and only seventeen of these took teaching posts in schools. There is a problem here, which I am not competent to discuss, of increasing the flow of science teachers in schools. The Institution should consider whether it can help to find a solution.

Much has been written about higher technological training, and in his address a year ago Colonel Leeson made some important observations on the subject. Since then further progress has been made in the joint discussions between the three Institutions, and their agreed views have been represented to the Minister of Education. It is, however, worth mentioning that at the present time there are about 6 per cent of unfilled places in the existing university accommodation in civil, mechanical and electrical engineering. With the extensions now in progress of the engineering faculties at several universities, there might well be in the near future 20 per cent of unfilled places. The proportion of undergraduates taking full-time courses in technological subjects is only 12 per cent of the full-time undergraduate population. Our study of requirements may show that this percentage is quite insufficient and that not only should the unfilled places be filled, but the longer-term extensions envisaged at the Imperial College and elsewhere should be urged forward without delay. The important point is that requirements and facilities should be reconciled.

A word about the training of technicians. Engineers have never in their work drawn a firm line between the qualified and the semi-qualified. They work together, as they must, in close harmony and co-operation. The standards of membership of this Institution must be maintained, but we should be on our guard against unnecessary exclusiveness which simply leads to the setting up of other and maybe unnecessary institutions, all jealous of each other and all adding to the confusion in the public mind, which fails to understand the differences between them. We should shoulder our responsibility in formulating adequate educational facilities and, if necessary, new organisations for technicians, who are the indispensable associates of the professional engineer.

A Planetary Hot Rolling Mill

A new hot rolling mill in which slabs are reduced to strip in a single pass, has been installed at the works of Ductile Planetary Mills, Ltd. This mill design was developed by the Sendzimir organisation and is known as a "planetary" mill. It produces strip from 6in to 15in wide and from 0·187in to 0·040in thick.

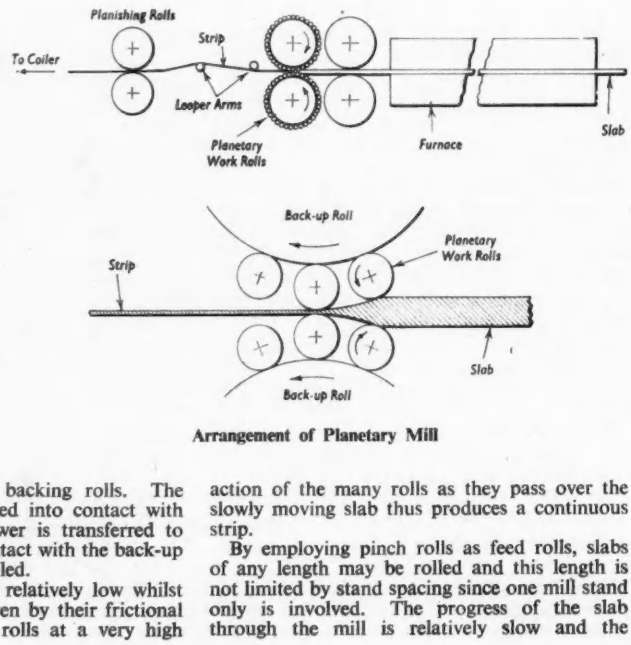
THE first commercial installation of a new design of hot strip rolling mill developed by the Sendzimir organisation has been installed at the works of Ductile Planetary Mills, Ltd., of Willenhall, Staffs. In this "planetary" design of mill slabs are reduced to strip in a single pass through a single mill stand. The arrangement of a planetary mill and the principle of its operation can be seen in the diagram we reproduce.

In the mill small work rolls are equally spaced round the periphery of large back-up rolls. Two such planetary assemblies—one top and one bottom—are mounted two-high in a set of mill housings. The work rolls are held in position on the backing roll by means of cages, and the cages and work rolls are free to rotate about the backing roll. The cages are geared together to ensure proper alignment and synchronisation of the work rolls, so that the rolls are always in the same position relative to the slab and to each other as the cages rotate.

Due to the very large roll-bite angle and the nature of the work-roll mounting, the slabs have to be pressure fed into the rolls at a constant rate by pinch or feed rolls, which are mounted in the same housing as the planetary assemblies. The planetary assemblies are driven in a two-high manner from a pinion stand connected by universal spindles to the backing rolls. The work rolls are spring-loaded into contact with the back-up rolls and power is transferred to them by their frictional contact with the back-up rolls and the metal being rolled.

The rate of slab feed is relatively low whilst the planetary rolls are driven by their frictional contact with the back-up rolls at a very high speed. It will be seen from the diagram that the upper back-up roll rotates in a clockwise direction and the lower one anti-clockwise. Thus the frictional drive to the upper and lower sets of planetary work rolls is in a direction against the pressure fed slab. As the slab is fed in, by virtue of the pressure imparted on the work rolls themselves to give their frictional drive, the cages carrying the planetary rolls rotate in a direction opposite to that of the back-up rolls and at a high speed to present continuously changing pairs of rolls to the slab. Thus a small movement of slab is fed to each passing work-roll, and since the slab is not free to move back each passing pair of work rolls roll out a short length of strip. The combined action of the many rolls as they pass over the slowly moving slab thus produces a continuous strip.

By employing pinch rolls as feed rolls, slabs of any length may be rolled and this length is not limited by stand spacing since one mill stand only is involved. The progress of the slab through the mill is relatively slow and the



Arrangement of Planetary Mill

Planetary Hot Rolling Mill

operation lends itself to progressive heating of the slab. For this reason the heating furnace is placed immediately adjacent to and in tandem with the mill itself and as the slab is brought up to rolling temperature it passes directly into the mill and is rolled to strip.

The slabs are butted end to end to give continuous operation and with this completely continuous operation, the furnace and mill elements and the heated slab all stabilise in temperature very quickly, which results in a particularly uniform product both physically and metallurgically.

The new mill of Ductile Planetary Mills, Ltd., can be seen in the photographs we reproduce on this page, and during a recent visit to the works we saw it in operation reducing 1¾in slab to 0·048in strip in one pass. The mill was built for the firm by W. H. A. Robertson and Co., Ltd., of Bedford.

Each planetary roll assembly consists of twenty-six 2in diameter work rolls equally spaced round a 20in diameter back-up roll. The cages in which the work rolls are mounted are coupled together by means of shafts and bevel gearing to synchronise movement in each roll assembly and between the two roll assemblies themselves. When the mill is started up it is necessary to drive the work-roll cage assemblies until the slab feed becomes effective, and for this purpose an independent motor drive is coupled to the synchronising mechanism for a short period.

The back-up rolls are driven through gearing at a speed of some 230 r.p.m. by a constant speed, 900 h.p., 500 r.p.m. motor and the work rolls rotate at about 3000 r.p.m. The back-up rolls are made of Hadfields' special roll metal and are mounted in heavy roller bearings, whilst the chrome vanadium work rolls are carried on needle roller bearings. The roll assembly can be drawn out of the stand as a complete unit when roll regrinding is necessary, and a standby assembly has been supplied in order that the mill does not have to shut down at such times. Special gear is fitted to facilitate the withdrawal and replacement of the rolls in the space of a few hours. The slides on which the rolls are withdrawn from the housing of the mill can clearly be seen in one of the illustrations.

The push rolls are 22in diameter, and in addition to making an initial reduction they also serve to push the slab through the planetary rolls at a speed selected according to the finishing gauge. The speed range of these rolls is variable from 4·5ft to 9ft per minute, and they are driven by a 30 h.p. variable speed motor. The slow movement of the slab and the much greater speed of the planetary rolls enable a small reduction of about 0·015in to be made each time the work-roll contacts the slab. In this continuous process it is vitally important that as soon as one length of slab is rolled another must immediately be fed on by means of the pinch and push rolls, and each following slab has to push the end of the preceding slab through the planetary rolls.

Immediately following the planetary mill is a two-high planishing mill, in which a further reduction can be made to obtain thin gauges and a high quality flat hot rolled finish. These planishing rolls are driven by a 200 h.p. motor with a variable speed of 14/43 r.p.m. Between the planetary and planishing mill a conventional looper arm is fitted in order to regulate the correct amount of strip tension and from the mill the strip passes on to a 100ft long run-out table leading to a coiler.

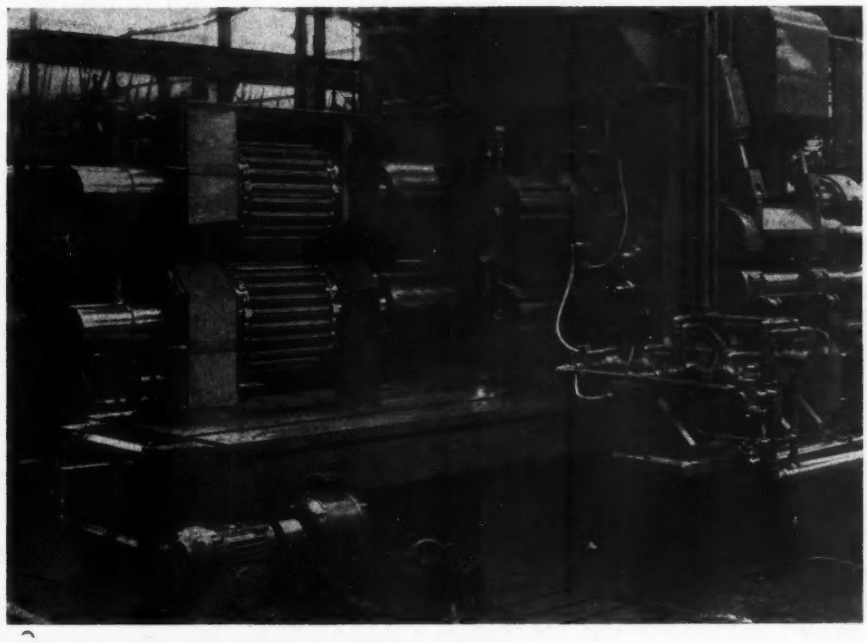
Adjustments to the push rolls, planetary rolls and the planishing rolls are carried out by conventional electrically operated screw-down gears and the motion is measured on a Selson drive, one of which is fitted for each screw-down mechanism.

The oil-fired furnace used for the mill was designed and built by the firm itself and consists of up to fifteen units arranged in line to form a continuous furnace at the ingoing end of the mill. Into this slab heating installation the slabs are fed lengthwise and conveyed continuously through the units by water cooled rolls. According to the slab heat required the number of furnace units can be varied, and the speed of travel is set in accordance with the desired speed of rolling. With this furnace arrangement slabs from 15ft to 45ft long can be handled to give coils up to 15ft wide and much heavier in weight than hitherto produced. A spare unit is kept at the side of the furnace so that should any individual unit collapse or require repairing it can be quickly removed and replaced without loss of production time.

The mill has been designed to produce 10 tons of strip an hour but so far the firm has found this amount can be gradually increased. The width of the strip produced ranges from 6in up to 15in wide and in gauges from 0·187in to 0·040in. The gauges are stated to be consistently accurate and experience so far has shown that a 30ft slab rolled into a coil does not vary more than 0·002in in thickness from end to end of the coil and across the width of the strip.

The firm states that it proposes not only to roll low carbon steels but to concentrate on carbon steels of up to 1 per cent, stainless steels, silicon iron and alloy steels, all of which can be rolled quite as easily in the new mill as low carbon steels. In these other metals it will be possible to roll strip down to as thin as 0·040in. The mill also enables the firm to produce small tonnages of strip of any specified particular width and gauge without loss of time or difficulty in resetting.

Ductile Planetary Mills, Ltd., is an associate of Ductile Steels, Ltd., and the planetary mill is laid down in the first shop built for the company on a new site. This shop has a 320ft long and 30ft wide main bay for the mill, and a 24ft wide bay at the side contains the power house, roll turning and grinding shop, stores, &c. A 100ft extension to the main bay is now in hand to provide storage room for the coils of strip.



Planetary Roll Assembly

THE ENGINEER

Vol. 196 OCTOBER 23, 1953 No. 5100

LEADING ARTICLES—
Craftsmanship and Intelligence 528
Swiss Railway Signalling and A.T.C. 528

ARTICLES—
Automatic A.C. Winder with Dynamic Braking. (Illus.) 535
British Internal Combustion Engine Research Association. (Illus.) 534
British Petroleum Equipment 513
Commonwealth Telecommunications 539
Craftsmanship 517
Development of Broadcasting in Great Britain. No. II 524
High-Speed Radial Drilling and Tapping Machine. (Illus.) 540
Institution of Mechanical Engineers' Annual Dinner 513
Instrument Works Extensions 536
International Motor Show. No. I. (Illus.)... 531
Iron and Steel Institute in Holland. No. II. (Illus.) 523
Lloyd's Shipbuilding Returns 513
North of Scotland Hydro-Electric Schemes. No. V—Part II. (Illus.) 514
Particle Accelerators at Hammersmith Hospital 513
Planetary Hot Rolling Mill. (Illus.) 526
Platinum Metals Exhibition. (Illus.) 530
Pneumatic Clamping Unit. (Illus.) 521
Portable Furnace for Heating Aluminium Alloy Rivets. (Illus.) 537
Rotary Metal Sampling Device. (Illus.)... ... 540
Sensitive Pressure Switch. (Illus.) 538
South Bank of the Thames... 513
Strengthening of Coquet Viaduct 536
Transducer System for Remote Indication. (Illus.) 537
Two Novel Fendering Systems. (Illus.) 519
Wind Tunnel for Railway Research 533

LETTERS TO THE EDITOR—
Gas Turbine and Diesel-Electric Locomotives... 530
Statically Indeterminate Prestressed Concrete Building 530

LITERATURE 529

NEWS AND NOTES—
Books of Reference 540
British Patent Specifications. (Illus.) 543
British Standards Institution 544
Contracts 542
Forthcoming Engagements... 544
Industrial and Labour Notes 541
Notes and Memoranda 542
Personal and Business 542

CRAFTSMANSHIP AND INTELLIGENCE

For years past, going right back to Victorian days, this country has been engaged upon improving its educational system. Educationalists in each generation, aware that opportunities for many brighter children to receive educations suited to their innate intelligence were lacking, have struggled to improve the situation. Two wars helped them. For both, and particularly the second, revealed a scarcity in this country, under emergency conditions, of men trained in science and technology. They received further encouragement from the report of the Barlow Committee which emphasised that the community needed more physicists, engineers and the like. For if universities were to double their outputs of science students as the Barlow Committee recommended, that number of undergraduates could only be reached by drawing into the universities brighter youngsters from all classes of the population. But as a consequence of the subsequent adoption of the Barlow policy, as professors and university functionaries have recently been pointing out, a curious situation has arisen. It is becoming, it seems, difficult for any reasonably bright boy to avoid university training—a very complete reversal (the evidence for which is contained in statistics of the high percentage of assisted students) of conditions in former days when only the rich and the better-off professional classes could afford university educations for their sons. Some educationalists no doubt welcome the change. But there are not lacking signs that there is some reaction, even amongst their number. For, as Mr. Roebuck put it in his Presidential Address to the Institution of Mechanical Engineers last Friday—an address of which we print long extracts elsewhere in this issue—" we older professional men must get it over to the younger ones that one of the lessons they have to learn is respect for skill and ability in engineering no matter what form it takes and that to have a capacity for abstract thought is not necessarily a greater gift of nature than to have the peculiar gifts of the craftsman."

There is certainly no harm in opening for all youngsters of brighter intelligence the opportunity to reach a university. Indeed, to-day, there must be very few bold enough to hold that it is not fundamentally right that that path should be open. But is it fundamentally right that all of brighter intelligence should necessarily follow that path ? We do not think so. For if it is insisted that all the brighter youngsters should reach universities the implicit assumptions are made that all types of intelligence are suited to an academic training and that intelligence is needed only for those jobs for which a university training fits a man. Neither of these assumptions is true. Sir David Pye, in his Presidential Address to the " Mechanicals " two years ago, stressed, for example, that young men with the spirit of design strong within them are best sought elsewhere than in the ranks of graduates. Mr. Roebuck, in his turn, stressed last Friday the importance of craftsmanship. Could he possibly agree that, the brighter lads having been taken away to become university graduates and technicians, the more stupid boys can be trusted to become skilled craftsmen ? Perish the thought ! He would, we feel sure, express his downright Yorkshire agreement with the remark of Sir Richard Southwell in his recent Trueman Wood Lecture to the Royal Society of Arts that " craftsmanship calls for very high intelligence ; but not for intelligence of the sort which it is, or should be, an aim of universities to foster." It is, of course, true that universities confer upon their graduates other qualities besides the capacity for abstract thought. Integrity, for example, is one of them. For it is a part of the academic discipline that truth may not be suppressed. Facts, however unwelcome in upsetting preconceived theories, must still be accepted. But is there not integrity, too, in craftsmanship ? Does not the young apprentice endure such a discipline that when he becomes the craftsman he cannot and will not let shoddy work pass out of his hands ? No engineer, we feel, who has seen craftsmen at work will doubt either the intelligence displayed or the depth of integrity involved. The more, then, is it a pity that the prestige of the craftsman is not what it was. For like Sir Richard Southwell (we are sure Mr. Roebuck would agree) we think " this country would risk industrial disaster if its whole reserve of intelligence were diverted into what were once called ' white-collar occupations.' " It is a very real danger. Let us hope it will be averted.

But Mr. Roebuck had more to preach than only the respect due to craftsmen. He was, indeed, at his happiest, in one of the most " human " addresses it has been our privilege to hear, in speaking about human relations in the works. The thought followed naturally from his deep belief in the virtues of craftsmanship that " in engineering no one group is any ' better ' than another. Whether as professional engineers, as technicians or as craftsmen, each is vital to the success of all." He emphasised, too, that engineers, because of their practical training in the shops and the respect they acquire there for craftsmen, are particularly well placed to bring about good and happy relationships in the engineering industry. For good relations are not to be acquired merely by the provision of recreation grounds, canteen facilities, medical services, and the like. Many a factory which has all those things has experienced recurrent industrial troubles. By contrast there are many works in which those things leave much to be desired, but in which, nevertheless, a spirit of co-operation and mutual understanding rules. For, as Mr. Roebuck said, " One can quickly establish the right relationship with a man by an approach to him on the level of his technical abilities and aptitudes ; he takes pride in these abilities and aptitudes and his self-respect is to a great extent based on them. This is much firmer ground for a real relationship than economics or social outlook." It is, indeed ! Too often to-day, even in engineering firms, that mutual respect is lacking. The men resist " new-fangled notions," suspicious both of their real value and their real object ; young innovators complain of " stick-in-the-mud " traditional methods. Yet both must contribute something if new methods are to be successful. There must be mutual understanding and co-operation between them. That is one of the reasons why the Institution of Mechanical Engineers insists before admitting a candidate to corporate membership that he must have had adequate experience in the shops. For only in the shops can that understanding be acquired.

SWISS RAILWAY SIGNALLING AND A.T.C.

Switzerland is a country that is lavishly provided with railways. Remembering that most of these railways wind their way beside lakes, and along deep valleys, or climb mountain passes amid some of the highest ranges of the Alps, it is extraordinary to realise that the route mileage per head of population is just double that of Great Britain. But the Swiss railways are perhaps more remarkable for the completeness of their modern equipment : the Federal system, and the various private lines are almost completely electrified, and since the year 1938 no new semaphore signals have been installed. While the exceptional nature of the country, and the severity of the winters impose very severe conditions for civil engineering maintenance and all-round operating, the relative

compactness of the system, with no more than 1772 route-miles of standard gauge on the Federal Railway, and the absence of far-flung lines of communication with sparse traffic, has brought a unity to the problems of line capacity and motive power that may well be envied on a railway system such as our own. But development is actively continuing, especially in the realm of A.T.C., and the present situation was described in a paper read before the Institution of Railway Signal Engineers last Wednesday, October 21st, by Dr. Karl Oehler, of the Integra Signal Company. He traced the original use of colour-light signalling, in 1929, to the need for improving signalling to provide for higher speeds consequent upon electrification; the distant signals had to be placed farther out, and colour-lights were installed to fulfil this important function.

From the very start, however, it was envisaged that within a certain definite period signalling on the entire system would be changed over to colour-lights. Such a programme would necessarily take time, and rather than change whole sections it was decided to adopt colour-light aspects identical to those displayed by the existing semaphore signals at night, so that no new operating regulations were necessary, and semaphores and colour-lights could be used side by side until such time as all the semaphores would be replaced. The semaphore signals used were of the German type, though in adapting the colour-light indications to accord with those older signals certain additional indications have been included in the distant signals, to advise a driver of the state of a junction ahead and whether reduction of speed is necessary. A high proportion of the total Swiss railway route mileage is over single track; the majority of lines are quite intensively used, with seventy to eighty trains a day, and Dr. Oehler described the interesting and expeditious method of block working, with electric locking, by which safe operation of the traffic is ensured. The development of control machines in Switzerland has progressed a little more slowly than in many other countries. The double-wire system of mechanical operation was in general use prior to the first introduction of power working, but between 1929 and 1944 thirty-five power interlocking frames of the distinctive Swiss type were installed, each having mechanical locking between the levers. It was not until 1939 that engineers of the Swiss signalling industry followed the general trend of development elsewhere and produced power interlocking frames without mechanical locking. In the year 1947 the practice of installing intermediate colour-light signals, which had been used so effectively on certain special sections of line in this country, was applied in Switzerland in a location of particular interest, in the middle of the St. Gotthard tunnel, 9¼ miles long. It was not merely a case of intermediate signals. Cross-over roads were provided, and with the aid of suitable switching arrangements at the stations at each end one-half of the tunnel could then be changed over to single-line working, if so desired. Similar arrangements have since been made on the section covering the northern approach incline to the tunnel. Both roads have been signalled for reversible working, thus enabling a more frequent service of trains to be run in one direction at any particular time. This follows the arrangements used on certain stretches of the French electrified main line between Paris and Lyons, where at certain times of the day both running lines are used for traffic in the same direction.

But to British engineers at the present time perhaps the most interesting part of Dr. Oehler's paper was that relating to automatic train control. Following upon a serious accident near Lucerne, due to signals being disregarded, the Swiss Federal Railways, after a series of trials in the "nineteen-twenties," decided to adopt the Metrum system, and to equip all their locomotives, electric motor coaches and railcars forthwith. This programme was completed in the "thirties," though it should be added that less than 600 motive power units in all were involved. Indication was given only at the distant signals by means of track inductors, though there was no source of power along the track. When the distant signal is at clear no indication is given in the cab, not because current is not flowing, but because it is diverted to a path where it does not affect the locomotive equipment. With the distant signal at caution a whistle is sounded and a brake application is made. The original installation covered all distant signal locations, but a further accident, during the war, when an adverse starting signal was ignored, led to the decision to equip the inner distant signals, and the starting signals. Again the programme, once decided upon, was carried through with commendable speed, and by the close of 1952 it was complete, with some 3500 signals fitted. In view of the projected scheme for large-scale equipment of British railway main lines with a warning system based upon the indication of the distant signal, this development in Switzerland is of particular interest. We have felt all along that any system of A.T.C. adopted here as a national standard should be capable of extension or elaboration, and the experience of the Swiss railways in finding it necessary to include signals other than the "distant" may indeed be a pointer to our own future needs. There is a further point, too. The present Swiss arrangement, like that developed on the Great Western Railway, includes an acknowledging button, by means of which the driver can forestall the automatic application of the brake following a caution indication. There is nothing to prevent a driver pressing this button in acknowledgment and continuing at undiminished speed. While we have not heard of any such irregularity in operating on the Western Region of British Railways, a serious accident from this cause did occur in 1951 on the Swiss Federal Railways. It is extremely interesting to learn from Dr. Oehler's paper that development is now proceeding in Switzerland towards eliminating the button and replacing it with a form of speed detection. This would, in effect, check whether a driver had obeyed the instruction given to him by means of the distant signal, and if he had not would apply the brakes automatically.

VENTILATING PRESSURE LOSSES IN MINE AIRWAYS.—An information bulletin just issued by the National Coal Board contains a series of twenty charts which enable the pressure losses in mine shafts, airways and faces of various sizes and with different kinds of lining, to be estimated quickly without calculation.

Literature

Manual on Rock Blasting. Editor-in-Chief, K. H. FRAENKEL. London: Atlas Diesel Company, Ltd., Beresford Avenue, Wembley. Price £5 5s.

THE writing and publication of a textbook on civil engineering construction methods is always a very difficult undertaking, as, apart from the day-to-day development of contractor's plant, methods change as rapidly as do fashions; consequently, by the time the book is published it gives a good historical description which can serve as no more than a guide to future work. The Atlas Diesel and Sandvikens Jernverks Companies, of Sweden, have made a sincere effort to overcome this difficulty by publishing this book in loose-leaf form.

Following an International Congress on the Driving of Tunnels in Rock, held in Paris in 1949, a committee was set up consisting of representatives of various private and state organisations in Sweden that are concerned with mining and civil engineering. This committee felt that there was a use for an international book on rock blasting, and arranged for contributions from Sweden, Switzerland, France and Germany. This international feeling is not confined to the source of the contributions, as the book itself is printed in four languages—English, French, German and Swedish. Each double page has four columns, one for each language, and the student of languages can spend a very profitable time comparing the translations. A section of the book is devoted to a glossary of technical terms used in mining and tunnel driving in the four languages, and this should prove a very useful aid to anyone reading technical articles in languages other than his own.

The first chapter deals with special geological features of the Alps, Jura region, Sweden, Norway and Finland, and a later chapter describes Swiss experiences in driving through unstable rock, from which can be gained an impression of the extreme difficulty of certain tunnel work. To offset this aspect, other chapters give very comprehensive graphs showing progress in driving tunnels plotted against a great number of variables. Drilling patterns and details of so-called classical methods of driving rock tunnels are also given in other chapters. One may read in the book about the interesting manufacturing processes involved in making tungsten carbide inserts for the drill steel and explosives for the blast holes. In a section dealing with compressing plant, details are given of a number of Swedish and American compressors, and a number of basic ideas are laid down for the design of the ideal compressor. The all-important question of ventilation is not missed, and a large number of graphs are given of ventilation of variables. The direction of ventilation in a tunnel is discussed at some length and good views are expressed on this subject.

Tunnel driving is a subject that leads to a great deal of controversy when under discussion. One authority will claim that detachable bits are the only answer to the problem of drilling blast holes in rock, while another will maintain that drill rods with tungsten carbide inserts built in are the only possible solution. The question of rigidly mounted drifters as opposed to air legs will also be debated with considerable feeling, while the direction of the flow of ventilating air gives rise to endless discussion. It usually happens that both parties to discussions such as these are right, because each will be dealing with his own particular problems, dictated by the conditions in his own particular tunnel. The *Manual on Rock Blasting*

does go a long way towards providing good data for those engineers who wish to embark on driving a tunnel. It is a pity that the book has been published without a detailed index ; it is to be hoped that its loose-leaf make-up may enable this fault to be corrected.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

GAS TURBINE AND DIESEL-ELECTRIC LOCOMOTIVES

SIR,—Perusing back numbers of THE ENGINEER, I read with interest the letter by O. S. Nock in the issue of June 13, 1952, entitled " Gas Turbine and Diesel-Electric Locomotives," particularly his reference to the suggestion expressed in a recent leading article, that " difficulty " might be found in allocating gas turbine electric locomotive 18100 of Western Region to duties worthy of its power. I have been intimately associated with the operation of both the Brown Boveri machine 18000 and of the Metropolitan-Vickers 18100, since their introduction to Western Region tracks. Both have been employed upon the West of England road, and have been tried exhaustively over the heavy gradients between Newton Abbot and Plymouth. Both are now confined (when in traffic) to operation between Paddington and Bristol, a run which offers no opportunity whatsoever for exertion of their capabilities, particularly those of 18100, whose tractive starting effort of 60,000 lb is wasted with trains easily worked by " Castle " class steam engines with a tractive effort of 31,625 lb.

Operating officials of Western Region have indicated clearly for a considerable time that they definitely regard these machines as a nuisance upon the system. I would therefore suggest with all sincerity that arrangements be effected to try their capabilities on the tracks of London Midland or Eastern Regions, where runs of sufficient mileage, with trains of appropriate weight and gradients sufficiently heavy, may provide opportunity of comparison with the performance of diesel-electric locomotives 10000 and 10100. Indeed, it may be that an attempt to advance beyond the established age of steam locomotion would incur greater appreciation upon these Regions.

WALTER T. HARRIS

London, October 13th.

A STATICALLY INDETERMINATE PRESTRESSED CONCRETE BUILDING

SIR,—In the issue of your journal of July 17th of this year there is an interesting description of a statically indeterminate prestressed concrete building (page 86).

In the article it is stated that as far as the writer is aware it is with one exception the only building of its kind yet erected. That exception is in the Belgian Congo. Your readers may therefore be interested to know of the rigid frame prestressed concrete tower which was built at Warragamba dam in New South Wales and was completed in July, 1953. This structure is almost 100ft high and houses various pieces of service equipment used during the construction of the dam. The Freyssinet system of prestressing is used throughout the construction, and a description of the tower and its construction can be found in *Constructional Review*, 25 (8) : 17 (December, 1952).

FRANK A. BLAKEY

Melbourne, Australia,
October 7th.

Platinum Metals Exhibition

ALL this week there has been open at Grosvenor House, Park Lane, London, a " Platinum Metals Exhibition," organised by the Institution of Metallurgists in conjunction with Baker Platinum, Ltd., Johnson Matthey and Co., Ltd., The Mond Nickel Co., Ltd., and the Sheffield Smelting Company, Ltd. It closes to-morrow at 8 p.m. The exhibition has been arranged to commemorate the announcement in 1803 by William Hyde Wollaston of his discovery of the metal palladium.

The metal platinum which gives its name to the group of metals which contains palladium, rhodium, osmium, iridium and ruthenium, has been known since the sixteenth century in Europe. In America it was known still earlier. For when Columbus discovered America primitive American Indians had already developed effective techniques for working alluvial platinum and gold which occur together in certain districts. Wollaston seems to have become interested in the metal while still at Cambridge training for the medical profession, and when in 1800 he decided to abandon his medical practice in favour of a career in chemistry and physics, he turned once more to an attempt to prepare malleable platinum more satisfactorily than by methods then current. It was during the course of that work that he discovered palladium. But the announcement to the world was made in a very odd manner. Anonymous advertisements were issued stating that " Palladium or New Silver," having properties that showed it to be " A New Noble Metal," could be supplied by Mr. Forster at No. 26, Gerrard Street, Soho. Possibly this singular method of claiming priority in discovery was prompted by a desire to keep secret the work then going forward towards success in making malleable platinum ; possibly also because Wollaston suspected that a further metal, later isolated and called rhodium, would be revealed, as, indeed, it was, by later work. Wollaston's name was not publicly associated with the discovery of palladium until 1805, although his discovery of rhodium was announced to the Royal Society in June, 1804. In the same year, Smithson Tennant, who had been associated with Wollaston financially and in his work, discovered iridium and osmium. The last to be discovered of the metals in the group, ruthenium, was not isolated until 1840 by a Russian chemist, Claus.

The exhibition at Grosvenor House contains a number of historical objects including the handbill announcing that palladium was obtainable from Mr. Forster, pages from Wollaston's notebooks and photographs of early jewellery made by American Indians. Its main object, however, is to show the now widespread uses of the metals, particularly in industry. The platinum metals are, of course, very expensive. But the commonly held opinion that their primary use lies in jewellery is quite wrong. Some 75 per cent of the total production of the metals is utilised in industrial applications. Nor are those applications, as many engineers might think, confined to small individual amounts as in instruments, electrical contacts, electronic valves, sparking plugs, pyrometric instruments and furnaces, &c. Such applications, very familiar to engineers, find a place in the exhibition, and reference is made to a perhaps less familiar application, that of palladium in brazing alloys recently developed for joining high-temperature materials, such as gas turbine parts. It is when uses of the metals in the chemical industry and in chemical laboratories and in the glass and textile industries are examined that quite large and heavy items of equipment can be found. Our engraving, for example, shows a group of spinning jets fabricated in platinum metals for use in producing viscose continuous filament such as rayon. In the wet-spinning process cellulose solution is forced under pressure through holes, as small in diameter as 0·002in in such precious metal spinnerets into an acid solution which coagulates it. The holes have to be held accurate to a permitted tolerance of the order of 0·00008in and the spinnerets must resist acid attack, be mechanically strong enough to resist deformation by the hydro-static forces involved and be resistant to erosive wear. Only the platinum metals can provide the combination of necessary qualities. In the glass industry, again, the exceptional resistance of the metals to corrosive attack, coupled with maintenance of strength up to temperatures of 1500 deg. Cent., has led to their use for crucibles weighing as much as 40 lb for the melting of optical and other glasses and for many other purposes, including " bushings " for the production of glass fibre. In the chemical industry other qualities of these noble metals have led to extensive use, particularly the ability of platinum and palladium to act as catalysts. One of the exhibits is a platinum-rhodium gauge for a 3m diameter ammonia burner, part of the equipment used in the manufacture of nitric acid and nitrates. Palladium also has a unique property. It will act as a filter for hydrogen. The impure gas being fed under pressure to one side of a palladium membrane at a temperature of 200 deg. Cent., hydrogen almost free from impurity can be drawn off from the other side. Of more direct engineering interest is the use of platinum and its alloys for making thin bursting discs in pressure vessels handling corrosive materials, more particularly fluorine compounds. The metals are, of course, widely used for making laboratory ware, crucibles, dishes, tongs, spatulæ, &c., especially ware used in accurate chemical analysis.

The exhibition was opened last Monday by the Duke of Edinburgh. He accepted on behalf of the Queen a powder box made entirely from metals in the platinum group.

Platinum Metal Spinning Jets

The International Motor Show

No. I

LAST Wednesday, October 21st, the Motor Show was officially opened at Earls Court in London by H.R.H. the Duke of Edinburgh. This year's exhibition is the thirty-eighth of its kind, organised by the Society of Motor Manufacturers and Traders, and it coincides with the fiftieth anniversary of the first event in 1903 at the Crystal Palace. Once again visitors may see under one roof the latest products from the industries of all the automobile producing countries, save only those behind the Iron Curtain. There are some familiar models, the design of which, having proved from the first fundamentally sound, shows little change since last year's exhibition. Visitors can also see a number of new models, British as well as foreign, and some models which have been substantially modified and improved.

Like most of the post-war international motor exhibitions, this year's show does not display any marked change from previous styles, nor are there any remarkable or novel technical innovations. One has to become reconciled to the idea that automobile engineering apparently has passed the phase of outstanding new developments and has settled down to a stage governed by steady, though less spectacular, detail improvements. There is hardly one automobile factory in the world which could show a new model at the occasion of each of the annual great international exhibitions. Apart from the enormous costs involved, such a policy might easily be regarded as an admission that the previous models were not a full success. Appearance, however, has become increasingly important since the war, for many users are always wide awake to coachwork changes, while improvements concerning technical details are often taken for granted.

In these circumstances one need not be unduly disturbed that the new cars exhibited this year are more or less of conventional layout and that no startling or even revolutionary changes in design are apparent. It does not necessarily mean that manufacturers are resting on their laurels, but that they do not feel justified in indulging in bold experiments at this stage, when there is no urgent technical or economical need for drastically changing basic designs.

There are more exhibitors, a greater area of display space and more models than at any previous show at Earls Court since the war. Not less than 186 different models are being shown by thirty-one British manufacturers, an indication that the industry is not prepared to accept the view that multiplicity is a handicap to lower costs and more competitive prices. Ninety-six further models are on view, eighteen of them made by American and Canadian firms and fifteen by Continental ones. It is one of the main attractions of this year's show that it is more fully international than before, since some cars made in ex-enemy countries are open to inspection for the first time since the war. The German car exhibits, for instance, are more numerous than at any previous London motor show.

This strong foreign participation, particularly from the Continent, suggests that, in view of the increasingly rising production in France, Germany and Italy, these countries are now using the unique opportunity of this impressive London shop window to launch an extensive drive for sales not only in the European market, but also in those overseas markets which take a considerable portion of the British car output. It is not likely that imports of foreign cars will ever play an important part in this country ; apart from the few manufacturers who assemble cars here, few have ventured to set up an extensive sales and service organisation, though recent trade agreements concluded with France and Germany provide for a limited exchange of vehicles. The high import duty plus the additional purchase tax is liable almost to double the basic price of foreign cars, thereby raising it considerably above that of comparable British cars. Nevertheless, that so many foreign cars are present at this year's show certainly adds to its general interest and provides opportunity to thousands of experts and students of automobile engineering to compare the salient features and respective merits of British and foreign designs.

In the past twelve months the situation from the potential buyer's point of view has changed considerably. For the first time the typical British motorist can make his way to Earls Court with the feeling that this show is once more intended for him as well as for his overseas contemporary. Since steel shortage is a thing of the past, production has been rising ; more cars have been coming on the home market and restrictions have been eased. Even though there is still a waiting list for a number of models, mainly in the class of small and middle-sized cars, this is the first " covenant-free " motor show. There is one more aspect worth mentioning which distinguishes this year's show, namely, that we are now approaching a time when the supply approaches the demand for new cars. With all restrictions on the flow of steel sheets and components removed, manufacturers have been building up to near-record production, and sooner or later the home market might have to absorb the excess, since the possibility of any considerable increase of car exports seems rather improbable. It is true that lately reductions in the price of certain makes have been announced ; these, however, are not large, rarely exceeding about 5 per cent of the basic price, and they do not greatly affect the potential market. With the full benefit of cheaper raw materials yet to be felt and with all the economies arising from large-quantity production, prices will have to fall substantially if the situation is not to develop critically for the motor industry.

It would be wrong to conclude from the fact that more cars are now available at the home market, that exports have suffered, although it is true that last year there was a certain drop in exports to Canada and Australia, caused mainly by credit restrictions upon hire purchase sales and by other circumstances over which our industry had no control. This temporary decline of overseas sales, however, has now been overcome ; in fact, statistics show that the industry's exports have been mounting rapidly since last spring. In May car exports rose above the 30,000 mark for the first time in twelve months, and by July they had reached 32,000 units, 12,000 more than in February of this year. Even August exports were over 4000 more than last year.

Just as the export figures have risen, so have the industries' successes in events in the international racing calendar and in other record breaking trials. Cars like the Jaguar, for instance, have played an important part in placing British sports cars among the leaders in the international field, and the part played by Aston-Martin, Austin-Healey, Bristol and Frazer-Nash models has been magnificent in support and has further enhanced British prestige in the sports car world. For this reason, in accordance with last year's practice, the organisers of the show have again allowed manufacturers the opportunity of displaying cars which have given outstanding performance in racing events and other competitions. They include, in Formula 2, the 2-litre racing cars of H. W. M. Cooper and Connaught, the latter fitted with a four-cylinder engine with Stuart Hillborn fuel injection, and in the Formula 3, the Staride, Cooper and Kieft 500 c.c. racing cars, the Kieft having a four-cylinder twin overhead camshaft engine.

In addition to these racing cars, several production sports cars which have gained fame in major international competitions are being shown. Among them is the 3·5-litre Jaguar " XK 120 C," a car which won the 1953 Le Mans International twenty-four-hour Grand Prix d'Endurance, covering the record distance of 2534·6 miles at a record average speed of 105·849 m.p.h. Other cars include the Aston-Martin " D.B.3S," a car which this year has achieved a great number of successes, the Austin-Healey " 100," which broke over 100 International, National and American stock car records at Bonneville Salts Flats, Utah, U.S.A., last September, and, of foreign cars, the Lancia " Aurelia " Gran Turismo Competition model of international fame.

In this display of special production cars the " Lincoln X 100," an experimental car with many outstanding features, is attracting considerable attention. This " dream car of the future," built by the Ford Motor Company of America, is not a new model and it will not be produced for sale to the public. It is powered by a 300 b.h.p. vee-eight engine with an entirely new induction system and has automatic power transmission with electrical gear selection. The front-wheel brakes are cooled by thermostatically controlled blowers and the sliding plastic roof over the driver's compartment is actuated in three ways, one of which is a moisture-sensitive electrical device which closes the canopy and the windows in the event of rain. The electrical equipment is considerable and it is said to need 8 miles of wiring for its various connections.

Interesting as these special cars are, the majority of visitors and prospective buyers are likely to pay more attention to the cars which they might actually be able to buy than in the hypothetical car of the future. The impressive display of expensive luxury and sports cars should not detract from the fact that, at least, as far as the home market is concerned, the importance of the small car is growing. The demand for a car of low initial cost, economical to run and easy to manœuvre, has been steadily increasing, and the time has actually come when the British motor industry is considering the demands of the home market more than hitherto. New British cars, the Standard " Eight " and the two new Ford models, " Anglia " and " Prefect," are being shown for the first time to the British public, though their details and specifications have already been publicised. Two more small cars, the two-door version of the well-known Austin " A30 " and the previous Ford " Anglia " of pre-war design, now marketed as " Popular " at a greatly reduced price, are further additions to the growing range of inexpensive British models. None of them are " baby cars," a term which, incidentally, was never used in any derogatory sense when applied

to some of our pre-war models, but are useful models in the low-price range, designed for what is really needed for this special market—economic motoring.

All the new small cars are designed to give, within the limits set by reasonable outside dimensions, adequate accommodation for four passengers and sufficient luggage. The makers have wisely refrained from over-emphasising appearance, ornamentation and roominess at the expense of additional weight with corresponding loss of performance. On the other hand, they have not adopted any noticeable tendency towards all-out austerity, but have furnished their vehicles with all those accessories and refinements to which the overseas markets are accustomed. The basic prices of the newer models range between £335 and £395, i.e. prices well below those of comparable Continental cars, and in this respect they ought to sell well abroad. In the home market the inflated prices, imposed by the 50 per cent purchase tax, might somewhat adversely affect sales. A substantial reduction of the purchase tax and of the fuel tax is essential to restore a healthy home market which in the future will be just as important to the industry as the export trade.

In surveying the various exhibits space permits only a description of some of the latest British models and of such foreign cars which are being displayed in this country for the first time and differ from their British counterparts in general layout and detail design. We begin our report with a description of the latest British small cars, which are attracting a great deal of attention.

At the stand of the Standard Motor Company, Ltd., the new Standard " Eight " is the centre of attraction (Fig. 1). The Standard Motor Company has considerable experience in the production of small cars and before the introduction of the " Vanguard " it had been making for many years a popular 8 h.p. car. The appearance on the market of this new model, which was heralded two years ago by Sir John Black, head of the Standard Motor Company, has been expected with great interest, and, for one reason or another, there had been a great deal of speculation whether the new car would conform with the conventional or the more advanced Continental idea of small car design. Anyone who might have expected the new Standard to be fitted with front-wheel drive, air-cooled or two-stroke engine, or some other unorthodox technical ideas will probably be disappointed. The new car, like all the other small British vehicles developed after the war, is basically of conventional design, representing in its whole conception a scaled-down version of the contemporary big car. This statement should not be regarded as an adverse criticism, for the most important problem in the design of the small car, namely, the provision of adequate passenger accommodation in relation to limited outside dimensions, has been handled with considerable skill. It is well known that it is possible to scale down the design within certain limits, but impossible to scale down the human frame ! The public, though prepared to accept smaller cars, undoubtedly demands sufficient space to allow driver and passengers to travel in comfort. This problem has been successfully approached by the company and the car certainly gives the impression that much thought, experience and research has gone into its design.

In short, the new Standard " Eight " is a four-seater car of attractive appearance with ample luggage space and satisfactory head-room and leg-room. Full use has been made of the total width of the body by recessed doors and by the elimination of interior panels, thus providing for adequate elbow-room and shoulder-room (Fig. 2). Although the whole design has been planned with a view to keeping down manufacturing and running costs, the car lacks nothing in essentials. It is powered by an 803 c.c. push-rod-operated o.h.v. four-cylinder engine of 58mm bore and 76mm stroke, i.e. by a power unit of exactly the same basic dimensions as that of the Austin " A30 " and the Morris " Minor." The engine has a compression ratio of 7·4 : 1 and develops 26 b.h.p. at 4500 r.p.m. with a maximum torque of 39 lb-ft at 2800 r.p.m. Contrary to the prevailing practice nowadays of splitting the crankcase in the plane of the crankshaft centre, the cylinder block has been carried well below the centre line, a stiffer structure. The crankshaft, amply dimensioned, is counterbalanced and the camshaft is fitted with " hyposine " cams, which allow high valve lifts at low acceleration. An interesting design detail is that the brackets carrying the rocker shaft are of aluminium alloy for the purpose of counteracting expansion differences and maintaining accurate clearance irrespective of the engine temperature. Inlet and exhaust manifold are cast integral with the usual " hot spot " for the incoming mixture from the carburettor, and ignition advance is effected automatically by centrifugal and vacuum control. The torque is transmitted through a four-speed gearbox—with synchromesh on the three upper ratios—to the final drive, which incorporates a hypoid bevel gear.

Fig. 2—Panelling and Interior Details of the Standard " Eight "

Fig. 1—The Standard " Eight "

The suspension system embodies independent coil-and-wishbone layout at the front and a live rear axle with semi-elliptic leaf springs at the rear. The brakes are hydraulically operated with two leading shoes at the front and the clutch withdrawal mechanism is also hydraulically operated. The unit-construction body of the Standard " Eight " is a pressed-steel stressed-skin structure, suitably stiffened by box section reinforcements and stress bulkheads. Two Y-shaped longerons, attached to the transverse cross member below the dashboard and, further, to the plates forming the inner wing valance, provide a sub-frame for the engine and for the front suspension assembly. This assembly is carried on a cross member insulated from the sub-frame by rubber bushes, a detail which considerably reduces body noise by road irregularities.

The interior of the car may appear somewhat austere, but the makers have con-

centrated on the essentials, with various, normally standard fittings available at extra cost. The large luggage boot has no external opening, but access to this compartment is gained by hinging forward the squabs of the rear seats ; for two-up travel the rear seats can be folded forward to increase the available luggage space. The layout of the instruments, consisting of a speedometer, a fuel gauge and indicator lights for ignition and oil pressure, is conveniently placed in front of the steering wheel and provided with a large hood to prevent reflections.

Fig. 3—New Version of the Ford "Prefect"

The Standard "Eight" has a wheel-base of 7ft, a track of 4ft 0½in and weighs dry about 13 cwt. With a power-to-weight ratio of 40 b.h.p. per ton the car has a lively performance, and a fuel consumption of 55 m.p.g. is claimed at a mean speed of 30 m.p.h.

In the last few years it had become increasingly clear that sooner or later the Ford Motor Company would have to replace the two popular pre-war models, the "Anglia" and "Prefect," by cars of more modern design. These two models, conceived about twenty years ago and since altered in detail design only, had been the cheapest cars on world markets for quite a long time ; they enjoyed a considerable popularity because of their simple construction, their reliability and last, but not least, because of the excellent service facilities of the widespread Ford sales organisation. Owing to a narrow track, a high centre of gravity and transverse springing (the latter a doubtful heritage from the old Ford "T" model) the cars were not very satisfactory in cornering and road holding and were unable to provide that degree of riding comfort which is taken for granted in modern cars.

There had been a certain amount of speculation as to the technical means by which the Ford Company would meet this problem, and it is interesting to note that the Dagenham designers have chosen practically the same method as their opposite numbers at the Ford Motor Company at Cologne, who were faced with the same task two years ago. The German company then introduced a new model, the Ford "Taunus," to replace the old model of the same name. This car, which was described on the occasion of our report of this year's Frankfurt Motor Show (THE ENGINEER, April 17, 1953), is a smaller version of the 1·5 litre "Consul" fitted with a completely redesigned side valve engine of the same basic dimensions as that of the old model, which, for all practical purposes, coincided with that of the Dagenham built "Prefect."

The main difference between the new "Anglia" and "Prefect" and the German product is the front suspension ; instead of the conventional wishbone and coil spring layout of the "Taunus" the new British cars employ the same simple and ingenious suspension system as the "Consul" and the "Zephyr." Slightly smaller than the "Taunus" in their overall dimensions, the new "Anglia" and "Prefect" weigh about 2 cwt less than the former, and this reduction in weight should have a favourable influence on their performance, flexibility and economy. Both models have the same mechanical layout and power transmission unit, and the same overall dimensions. In fact, apart from radiator design and some interior fittings, the only difference is that the "Anglia" is a two-door saloon while the "Prefect" has four doors (Fig. 3). Basically they are scaled down versions of the "Consul" and, like this car, they are of integral pressed steel construction. The big problem for the designer, that of achieving a pleasing appearance and good proportions without sacrificing head-room and leg-room, has been skilfully solved. The new models are roomy, comfortable and have generous luggage room.

The four-cylinder engine of 63·5mm bore and 92·5mm stroke has a capacity of 1172 c.c. with a compression ratio of 7 : 1. It has a maximum output of 36 b.h.p. at 4400 r.p.m. Although bore and stroke are the same as that of the old "Prefect," the engine has been completely redesigned : the counterbalanced crankshaft has been considerably stiffened, the valve tappets are now adjustable, circulation cooling by a water pump has been adopted and a thermostatic control installed. A further useful addition is the preheating of the mixture by a "hot spot" device in the inlet manifold, the temperature of which is thermostatically controlled by circulating a part of the exhaust gases round the carburettor intake riser. The torque is transmitted through a three-speed gearbox with synchromesh on second and top gear ratios and through an open propeller shaft to the spiral bevel three-quarter floating rear axle. The brakes are hydraulic with two leading shoes at the front, and the clutch withdrawal mechanism is also hydraulically operated. The cars have a wheel base of 7ft 3in, a track of 4ft and weigh about 15 cwt. The makers claim lively acceleration up to maximum speeds exceeding 65 m.p.h. and a fuel consumption of 46 miles per gallon at an average speed of 40 m.p.h. This claim may appear rather optimistic, but with a power-to-weight ratio of about 48 b.h.p. per ton the new Ford cars are bound to have a favourable performance and economy. Instruments are grouped in a binnacle immediately ahead of the driver for easy reading between the two-spoked steering wheel (Fig. 4).

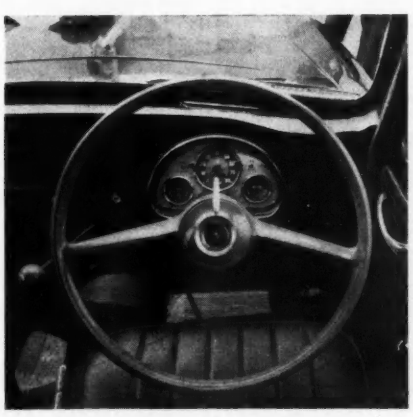


Fig. 4—Control and Instrument Grouping on the New Ford "Anglia"

Though the old 8 h.p. "Anglia" of pre-war design must now be considered rather old-fashioned, it is far from being obsolete. There are certainly many motorists who might have learnt with satisfaction of the announcement made by the Ford Company on the eve of the opening of the show that the manufacture of this car is going to be continued as long as the demand for it remains. This decision seems to be sensible, as jigs and tools have long since been paid for. It has the 1200 c.c. engine of the old "Prefect," but no other changes are being made in the equipment and finish, but the price has been reduced and the car will be marketed under the name of "Popular." It probably becomes by a considerable margin the cheapest car in the world.

(To be continued)

Wind Tunnel For Railway Research

A NEW closed-jet, return-flow wind tunnel has been installed at the Derby works research department of British Railways to replace the tunnel built for research purposes by the former London, Midland and Scottish Railway Company in 1935. The new tunnel was built to the requirements of British Railways by the Airscrew Company and Jicwood, Ltd., and it is some 65ft long. It is operated by an airscrew driven by a 50 h.p. motor which is designed to draw air through the working section at speeds of up to 100 miles an hour. The tunnel itself is of wooden construction and the joints between the sections in which it is built have resilient gaskets incorporated flush with the inside walls to ensure air tightness. This is the only wind tunnel operated by British Railways and it is to be used for the study of air flow on scale models of various details under controlled conditions. It will also provide data for the design of locomotives and rolling stock and structures. Amongst the subjects to be studied will be improved train ventilation, dispersal of smoke and steam ; the wind resistance of wagons used on high-speed freight trains, the design of draught-proof signal lamps, extraction of smoke from engine sheds, and the cooling of diesel locomotives.

THE MANUFACTURE OF PORTLAND CEMENT.—The Cement Marketing Company, Portland House, Tothill Street, London, S.W.1, has produced a coloured film showing the various processes which are necessary for the manufacture of Portland cement. The film shows work in progress at a number of the quarries and works of the Blue Circle group of companies. Various methods of winning the raw materials—chalk or limestone and clay—are depicted in the early part of the film, and the various manufacturing processes, such as the preparation of slurry, the operation of the kilns, and the grinding of clinker, are subsequently shown and explained. The film lays emphasis on the tests carried out at various stages of manufacture to achieve quality control.

British Internal Combustion Engine Research Association

Some of the research work in progress or recently carried out by the British Internal Combustion Engine Research Association at its laboratories at Slough, Bucks, is briefly described hereunder.

ON Thursday and Friday of last week, the British Internal Combustion Engine Research Association gave demonstrations at its laboratories at Slough, Bucks, of the research work now in progress there, and of several items of research which have recently been completed. Some brief notes describing some of this work are given below.

High-Pressure Turbo-Charging.—A particularly interesting research concerned the development of a variable compression ratio piston, which is described in its application to petrol engines under the next heading; some indication is first given, however, of the related work on a compression-ignition engine.

Turbo-charging work carried out on a Mirrlees "TL3" experimental engine demonstrated very clearly a serious limitation in the conventional method of turbo-charging. When the original atmospherically charged engine was modified for turbo-charging, the compression ratio was lowered in accordance with normal practice to accommodate the increase in air charge pressure. When successive improvements to the turbo-charging system had raised the output to 252 lb per square inch brake mean effective pressure at 600 r.p.m. the maximum cylinder pressure, 1200 lb per square inch, was 350 lb per square inch higher than the working pressure for which the engine was designed, in spite of the fact that the fuel injection period was excessively long (50 deg. crank angle). A further reduction in compression ratio was not practicable, since the running at low loads was already rough because of the long ignition delay period resulting from an inadequate air compression. Moreover, the existing compression ratio was barely sufficient for starting. It was known that one firm had resorted to the use of an engine designed for very high maximum cylinder pressure and in this way had achieved brake mean effective pressures up to 300 lb per square inch, though at a lower piston speed than in use on the Mirrlees engine, so that the output per cubic inch of swept cylinder volume was about the same.

It was considered, however, that this solution would not prove generally acceptable, since it involved greatly increased loadings on every major part of the running gear of the engine. Moreover, the fundamental defect remained, namely, that with the boost pressure varying between 0 lb and 30 lb per square inch gauge the compression pressure varied by a ratio of about 3 to 1. The maximum cylinder pressure reached 2100 lb per square inch gauge at 300 lb per square inch brake mean effective pressure.

In view of the increase in wear rates and other difficulties to be expected at such high cylinder pressures, it was considered that a more commercially practicable method would be to use a moderate cylinder pressure at full load by employing a somewhat lower compression ratio (and also using a lower boost pressure with greater air utilisation) and to maintain the maximum cylinder pressure near to the same value as the load was reduced, by progressively raising the compression ratio. This offered the following advantages:—

(1) The achievement of very high outputs without exceptionally high loadings of engine components.

(2) High expansion ratios at part loads giving throughout the load range the highest thermal efficiency permitted by the strength of the engine whatever this might be.

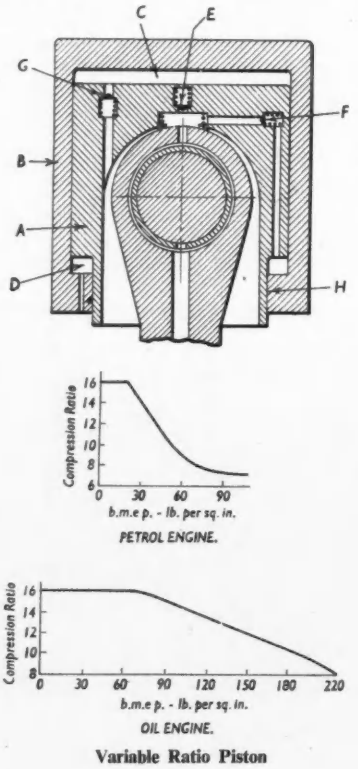
(3) Maintenance of optimum compression conditions for combustion throughout the load range.

(4) Easy starting by virtue of a high compression ratio.

To achieve these attractive features it was necessary to find satisfactory means of varying the compression ratio of the engine in accordance with the load, and the variable-ratio piston was conceived. It was first developed on a petrol engine and recently three pistons of this kind have been fitted to this engine and they are behaving very well. Modifications to the turbo-charging system and the fuel injection nozzles are required before full advantage can be taken of the pistons and very high loads obtained, but improvements have already been gained in starting and in fuel consumption at lighter loads where the compression ratio rises to a maximum value of 16 to 1. The piston is arranged to reduce the compression ratio progressively to a minimum of 8·3 to 1 at very high loads. With the existing turbo-charging system and injection nozzles it is possible to demonstrate the operation of the pistons over a fairly wide load range.

Another limitation met in the course of the work was that even with the largest elements in use, the existing fuel injection pumps delivered the fuel at too low a rate so that the injection period occupied 50 deg. of crank angle at the highest load reached. The use of larger pumps would have made necessary the provision of a very heavy camshaft and drive which are clearly undesirable from several points of view. Instead a hydraulic-servo-operated system was developed and applied to this engine.

It appeared better to take the necessary energy continuously from the engine crankshaft, store it temporarily and then release it at the appropriate time to operate the plungers. A gear pump driven from the crankshaft with an almost uniform torque supplies fuel oil at a pressure of about 1000 lb per square inch to accumulators arranged near each pump. The passage of oil into an accumulator compresses a quantity of air which is separated from the oil by a flexible diaphragm. On the opening of a port by a balanced piston valve, the air re-expands forcing the oil into a chamber, where it acts on a piston connected to the injection pump plunger. The injection pump proper is of conventional design. An interesting detail of the design is a dashpot which at any rack setting commences to decelerate the plunger as soon as the spill port has been uncovered at the end of the effective stroke. This device was developed to eliminate secondary injection, and has the added advantage that the pump may be used to give pilot injections.



Variable Ratio Piston

Bicera Piston Application to Petrol Engines.—It was apparent from the work mentioned above that variable-ratio pistons would serve a very useful purpose in petrol engines and other throttle controlled engines. The limitation of the compression ratio of a petrol engine to the normal value of about 7 : 1 is only necessary at full throttle. At part loads much higher compression ratios can be used without detonation. The variable ratio piston provides a progressive increase of compression ratio as the throttle is closed, and, by virtue of the increased expansion ratios, gives corresponding increases in thermal efficiency. The illustration shows the principle of operation of the piston.

The piston is composed of two main pieces *A* and *B*. *A* is an inner portion termed the "carrier" which is mounted on the gudgeon pin in the conventional manner. *B* is an outer portion termed the "shell" which slides over the carrier, thereby changing the compression ratio. These two parts are arranged to form an upper chamber *C* and a lower annular chamber *D*. The two chambers are kept full of lubricating oil which is supplied to them from the engine oil system via the connecting-rod and the non-return valves *E* and *F*.

The load due to the gas pressure acting on the crown of the piston is carried by the oil in the upper chamber. When during the engine cycle of operations the gas pressure reaches a chosen value, a spring-loaded relief valve *G* opens and oil is discharged to the engine sump, allowing the upper chamber to contract. This arrangement ensures that the maximum cylinder pressure does not exceed a selected value.

In order to move the shell in the other direction so that the highest compression ratio consistent with the chosen maximum pressure is always maintained, use is made of the inertia force of the shell and the oil in the connecting-rod and upper chamber acting during the latter part of the exhaust stroke and the first part of the inlet stroke. This inertia load is carried by the oil in the lower annular chamber, which is forced out during this part of the cycle through the clearance at *H* between the carrier and shell.

When the engine is running at a steady load, the shell moves up (i.e. towards the higher ratio position) a few thousandths of an inch under the inertia action. This raises the compression ratio slightly and produces cylinder pressures just sufficiently high to open the relief valve and discharge a very small quantity of oil from the top chamber, so that the shell moves down again on the carrier. Thus the compression ratio remains substantially constant at a value giving the desired cylinder pressure.

If, now, the engine load is raised, there is an increased discharge through the relief valve due to the momentarily increased cylinder pressure and the shell moves down in a few cycles to a new position of equilibrium. If the load is decreased, the cylinder pressures diminish and the relief valve remains closed for a few cycles. The cyclic discharge of oil from the lower chamber continues, raising the compression ratio until the cylinder pressures are again sufficiently high to operate the relief valve.

The change of ratio produced by the piston is similar in the atmospherically charged petrol engine to that in the highly turbo-charged compression-ignition engine, but the ranges of brake mean effective pressure over which this change occurs are different and, moreover, the maximum pressure for which the piston is set is, of course, very much higher in the compression-ignition engine. The development of the piston for petrol engines has been carried out on a single-cylinder engine of 1 litre capacity, a curve of compression ratio against brake mean effective pressure obtained on this engine showing a substantial fuel saving at part throttle at an engine speed of 1600 r.p.m. The gain in efficiency is at present somewhat less at higher and lower speeds, but, we are informed, the Association is

rapidly improving the piston in this respect by attention to detail, and this phase of the development is approaching completion. Pistons of this kind have been fitted to a six-cylinder, 1·5 litre car engine and are at present in process of adjustment before performance tests. The piston position is determined by a simple indicator which consists of a lever turned on its pivot until the inner end is just tapped by the shell of the piston at the bottom of the piston stroke. The indicator is only necessary for experimental purposes. The piston itself is entirely self-contained and automatic.

Lower Grade Fuels in High-Speed Engines.—In recent years, economic benefits have been obtained in large marine diesel engines by the use of boiler fuels. There is naturally a similar urge to use cheaper fuels in smaller engines. The fuels concerned in this latter case are those which meet the Class B requirements of B.S. 209, but fail to meet the Class A requirements usually in regard to sulphur content and Conradson carbon value.

The major troubles which were found to occur when such fuels were used in smaller engines were excessive wear of the piston rings, ring grooves and cylinder bores. Severe pitting of the inlet and exhaust valves and seats also occurred, and on the smaller engines particularly, severe scuffing of the piston top land. Increased deposits of carbon accompanied by rapid contamination of the lubricating oil were also evident in all the preliminary tests. The thermal efficiency of the engine was not greatly affected. The grand total of running hours on eight test engines exceeded 25,000 hours. The findings have enabled recommendations to be made regarding not only the design but also the maintenance of engines in which lower grade fuel may be used. The investigation is still proceeding.

Torsional Vibration.—Accurate assessment of the torsional stiffness of engine crankshafts is of great importance in the many cases where engines are coupled to driven machines in such a way as to produce considerable torsional vibration. The first stage of the Association's work in this connection was to produce a provisional empirical formula for crankshaft stiffness having constants adjusted to suit the range of crankshafts employed by member firms. It was realised, however, that this could not make proper provision for the effects of the many alterations in design that might occur as engine development proceeded. The problem was to establish a general method enabling each individual feature of the crankshaft to be correctly evaluated as a contributory element of the total stiffness of the crankthrow.

Beginning with the simplest test, i.e. stepped cylindrical shafts, the effects of fillet radii and diameter ratio were determined using a torsion rig designed and built in the laboratory for static and dynamic tests, the measurements being taken with an optical auto-collimating system. The additional flexibility due to the junction was expressed as an equivalent length of the shaft. This method of interpretation was found most suitable and was applied to all further stages of the investigation.

Crankweb features were studied, first individually and then in various combinations as parts of the crankthrow design, using this web test rig arranged to produce torsion without bending. A wide range of crankshaft shapes and proportions was studied. It is now possible by means of the basic data thus obtained to determine the equivalent length of every individual factor affecting the flexibility of a crankshaft. Incidentally, the information obtained also makes it possible at the design stage to determine directly the effect of any modification considered.

Since the completion of this work, this method of stiffness evaluation has been successfully applied to a large number of crankshaft designs. This figure shows that the agreement between measured vibration frequencies and calculated frequencies of engine systems is substantially better with this rational method than with any other previously used.

Automatic A.C. Winder with Dynamic Braking

SOME months ago a 1225 h.p., 6·6kV automatic a.c. winder was commissioned at the National Coal Board's Lynemouth No. 2 shaft, near Newcastle. The winder is designed for automatic control or for manual control, either from the engine house or from bank. It is equipped with dynamic braking operated on the Metropolitan-Vickers transductor-controlled system, with d.c. supply taken from a grid-controlled mercury-arc rectifier (Fig. 3). This installation is believed to be the first automatic winder to use dynamic braking. Its commissioning recalls the earlier high-speed automatic a.c. winder which was also designed by the Metropolitan Vickers Electrical Company, Ltd., and was installed by the Ashington Coal Company, Ltd., at Lynemouth No. 1 shaft.

In the new installation (Fig. 1) automatic control is used for normal winding operations, but local manual control is available for use during special maintenance work ; there is an orthodox arrangement of the electrical control lever and mechanical brake lever, giving the driver a direct view of the drums and depth indicator. The driver's electrical control lever operates directly an oil servo controlling the liquid controller, and his brake lever operates directly the brake control valve. Single-slot lever gear is employed so that the driver is not called upon to move his electrical control lever in any direction except forward and reverse, irrespective of whether power or braking is required.

Remote manual control is provided for normal " men " and " service " winding. An electrical control lever and a mechanical brake lever are installed at the bank position (Fig. 2) and they operate through remote control servos to the winder house. A remote-operated miniature depth indicator, also at bank, enables decking operations to be carried out. The driver's electrical control lever is coupled to the slider of a potentiometer, which is supplied with a constant d.c. voltage from a stabilised source. The voltage selected by the driver is fed into the moving coil element of an electro-hydraulic servo, causing the output ram of the servo to take up a position dependent on the voltage. The output ram is coupled mechanically to the main oil servo control valve operating the liquid controller, so that every movement of the ram causes a corresponding movement of the oil servo. Hence, for every position of the remote electrical control lever there is a corresponding position of the liquid controller, and the driver at bank can thus control the torque of the winder.

For remote operation of the mechanical brakes the remote brake lever is coupled through gears to a power Selsyn which, in turn, is connected electrically to a receiver Selsyn situated in the winder house. The receiver Selsyn controls the position of the control valve of the brake engine, and thus, for every movement of the remote brake lever, there is a corresponding movement of the mechanical brake in the winder house.

The primary function of the Lynemouth winder—the raising of coal in 5-ton mine cars—is done automatically in response to push buttons operated by the banksman, who, in addition to starting the winder, operates the car tippling arrangement. One of the control cubicles is shown in Fig. 4, in which the dynamic braking tray is partly withdrawn.

Automatic winding is carried out on the closed loop system, in which the required speed signal

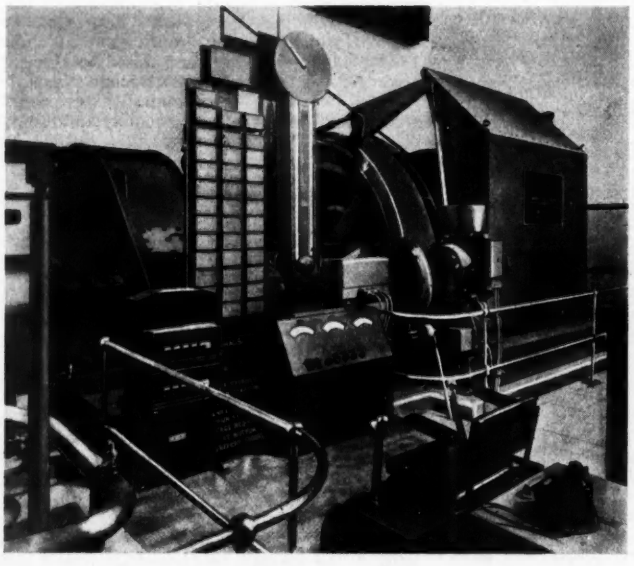


Fig. 1—1225 h.p. Automatic A.C. Winder at Lynemouth Colliery

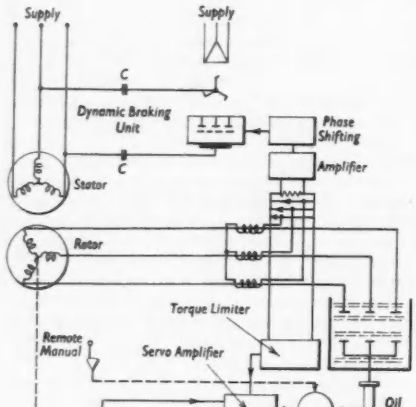
Fig. 2—The Bank Control Position at Lynemouth

(derived from a potentiometer actuated by unidirectional cam gear) is electrically compared with the actual speed signal (derived from a tacho-generator driven by the winder); the "error signal" resulting from the difference in speed is used to operate the liquid controller. To do this the error signal is amplified and fed to the electro-hydraulic servo, which in turn actuates the controller. The torque applied to the winder depends on the magnitude of the speed error and the selection of power or braking torque is determined by the polarity of the error. A torque-limiting circuit prevents the winder from being subjected to more than twice full load torque. In the simplified block diagram (Fig. 3) the forward and reversing contactors in the stator supply leads are not shown.

Although the winder is intended to operate automatically on raising duty only, the tests conducted during commissioning were carried out with various raising and lowering loads. Throughout these tests the winder operated automatically, including the final landing on keps.

To simplify the scheme, acceleration control is not fitted, and on automatic operation the winder is allowed to accelerate freely, whether raising or lowering, under the influence of the available torque; thus it is governed only by the peak torque permitted by the control system. This method allows the winder motor to develop the peak torque during all accelerating periods and thus reduces the time of winding when a load less than the maximum is being raised or any load is being lowered.

For raising loads the motor is run at sub-synchronous speeds as on a normal winder, but for the lowering wind it was considered that a more economical arrangement would obtain if the motor was allowed to run above synchronism, i.e. regenerating. Accordingly, the control system is arranged so that when lowering a load the motor operates regeneratively during the



Forward and Reversing Contactors Omitted.

Fig. 3—Schematic Diagram of A.C. Hoist Control

full speed period. Whether raising or lowering, the winder is retarded by dynamic braking and the commissioning tests showed that the rise in speed when transferring from regeneration to dynamic braking had been kept to less than 3 per cent; the time for raising full load was 30·25 seconds and the time for lowering 29·25 seconds.

Since this winder is intended primarily for automatic raising duty a comparison was made of the effect of load on the retardation period; tests showed that the speed-time curve was very consistent for loads of 2¼ tons, 4¼ tons and 5¼ tons; this indicates the high accuracy obtained with the speed control system. A series of tests was also conducted at an artificial bank (without

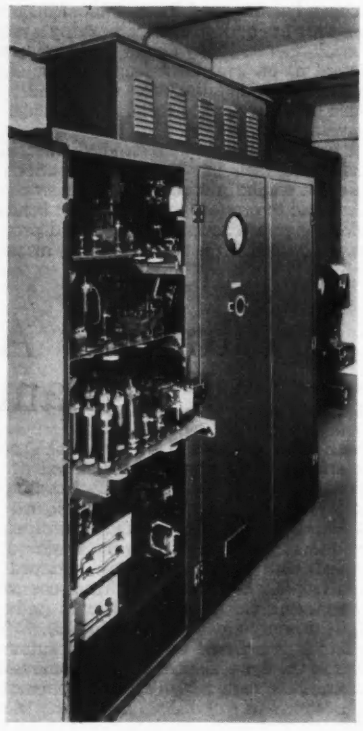


Fig. 4—Cubicle with Dynamic Braking Speed Control Trays

using keps), applying the full braking effort to stop the cage once the minimum creep speed had been attained. It was found that the stopping accuracy was within ±1½in for all raising loads. These results suggest that the accuracy and precision obtainable on an a.c. winder with dynamic braking and closed loop control make it comparable with the Ward-Leonard winder for automatic operation.

Strengthening of Coquet Viaduct

THE Coquet viaduct, which carries the East Coast main line over the River Coquet between Acklington and Warkworth, north of Newcastle, has been strengthened. The viaduct was constructed in 1847. It has nine 50ft arch spans and two approach spans of 12ft. The piers are of solid masonry, but the arches are in brickwork, 2ft 6in thick at the crown and 3ft 6in thick at the springing, faced with masonry voussoirs. The piers, which range in height from 50ft to 78ft, are 8ft thick at springing level and have a face batter of 1 in 54. The "rise" of the 50ft arches is 10ft.

In 1925, to counteract an observed outward movement of the spandril walls, star plates and tie-rods were fixed to each span. From 1945 onwards deterioration in the condition of the brickwork in the arch soffits was kept under close observation, and in 1951 it was decided that strengthening must be proceeded with. Tie bars were first provided between all piers to reduce the "spread" under loading at arch springing level. The ties consisted of old rails spanning across each arch longitudinally below springing level, between the tops of the piers. A positive fan fix was provided at each abutment. A reinforced concrete distributing beam was constructed, with five old rail needles through each pier. The tie bars were bolted to the projecting needles by forged links at one end and forged turnbuckles at the other. The design of the tie rails and their fixings was based on a requirement to carry 75 per cent of the calculated unbalanced horizontal thrust due to live load, being approximately 9 tons per foot run of pier. The rail ties were all in position by January, 1953. Pretensioning was limited to that which could be carried out by one man using a bar giving a leverage of 2ft.

The second stage of the strengthening work was to construct reinforced concrete arches, 9in thick, beneath the arch brickwork of each span. These lining arches have been provided to reduce the deformation gradient in the width of the arches when one line only is loaded, this having been the cause of severe longitudinal cracking approximately along the centre of the arches, and as an alternative to the cutting out and replacing of the loose brickwork in the soffit. Steel-framed centering was provided for the casting of the concrete arch linings, supported on the distributing beams at piers which had been provided with the new arch ties.

Grouting tubes were built into the new arch concrete and any gap existing between the arch brickwork and the new concrete lining was filled with cement grout under pressure. When this had been completed the grout tubes were inserted to a further depth of approximately 15in into the old arch brickwork and grouting into the brick arches was then carried out. The two lower rows of tubes at each pier were then drilled through to the extrados of the brickwork to act as weep holes and assist in the drainage from the backs of the arches.

Deflection tests were carried out in July, 1953, and the results compared with similar tests undertaken just before the work had been started. They showed that the desired effect has been obtained, and deflections and deformations have been very appreciably reduced. Throughout the whole period under which this work was in progress it was only necessary to impose a speed restriction on the running of traffic over the viaduct for a very limited period, whilst the new concrete lining to one of the most severely deteriorated arches was being placed. The contract work was carried out by Wellerman Bros., Ltd., of Sheffield, and the whole of the work was carried out under the direction of Mr. A. Dean, Civil Engineer, North-Eastern Region, British Railways.

An Instrument Works Extensions

NEW extensions, recently opened at the Letchworth works of the Sigma Instrument Company, Ltd., have increased the productive floor space to some 45,000 square feet. With the opening of these extensions it has been possible to reorganise the layout of the works and augment the productive equipment with a number of new machine tools. A new shop, 140ft long by 70ft wide, has been laid out for the assembly and testing of the firm's multi-dimension inspection machines, comparators and standard instruments of various kinds. A balcony at one end of this shop provides accommodation for a stores for finished instruments and a demonstration room. At the opposite end of the shop an adjoining building houses a design and drawing-office, whilst a two-storey extension provides offices for the technical and commercial staff. Another new single-storey building, with a floor area of 5000 square feet, contains plating, heat-treatment, fettling and maintenance departments. When the new buildings were placed in service the original works building, which covered some 18,000 square feet, was reorganised to house a larger machine shop, with its associate standards room, planning department, experimental section, tool stores, and an assembly and testing department for gas instruments.

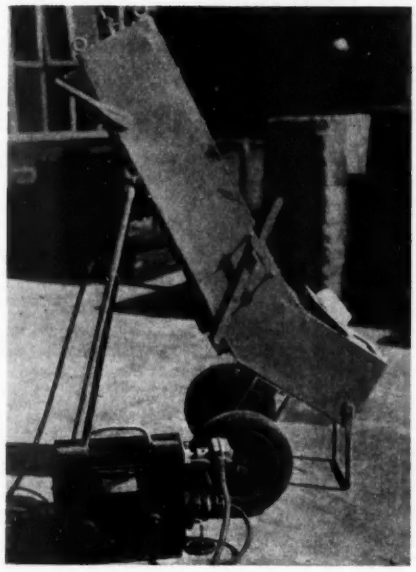
OVERHEAD CONVEYORS.—A new design of overhead chain conveyor supplied by Geo. W. King, Ltd., of Stevenage, is supplied in parts ready for erection by the purchaser. Its component parts are ready drilled, and the hangers used have swivel attachments that enable them to be fixed at any angle. The maker states that the only tools needed for installing one of these conveyors are a hacksaw, a spanner and a clamp. The rated load capacity of each conveyor trolley is 100 lb, and heavier loads can be carried by special arrangements. The conveyor can be arranged with vertical bends of up to 90 deg. and horizontal bends can normally be made of 2ft radius, but down to 1ft if necessary.

CONFERENCE ON DEFECTS IN CRYSTALLINE SOLIDS.—The H. H. Wills Physical Laboratory of the University of Bristol, in co-operation with the International Union of Pure and Applied Physics and with the Institute of Physics, is organising a conference on "Defects in Crystalline Solids," to be held from July 13 to 17, 1954, in Bristol. Dislocations will be discussed mainly in their chemical aspects, as influencing diffusion and precipitation in the solid state, rather than in relation to plastic flow. Particulars may be obtained from the Secretary, H. H. Wills Physical Laboratory, Royal Fort, Bristol, 8, or from the Secretary, The Institute of Physics, 47, Belgrave Square, London, S.W.1.

Portable Furnace for Heating Aluminium Alloy Rivets

THE technique of driving aluminium alloy rivets up to a diameter of $\frac{3}{4}$in is well established, but for a number of reasons it is difficult to drive rivets of a larger diameter under practical conditions. However, by heating aluminium alloy rivets of suitable composition to a temperature between 400 deg. and 500 deg. Cent. an appreciable increase in the ease of driving is obtained and rivets up to $\frac{7}{8}$in diameter can be readily driven under most conditions. Alloy N6, B.S. 1476, an aluminium 5 per cent magnesium alloy, is commonly used for large rivets and is very suitable for hot driving. To meet the need for making available equipment for heating rivets to the intermediate temperatures mentioned, the Aluminium Development Association has recently developed and completed a rivet heating furnace which is suitable for use in shipyards, structural engineering shops, and for site work.

It is extremely difficult to meet the requirements for such a furnace, since it must be capable of maintaining the temperature of the rivets within the limitations stated above and must also maintain a high output of rivets for short periods, while at the same time be capable of holding rivets within the temperature range for any



Portable Furnace for Heating Aluminium Rivets

reasonable period that may result from delays in preparing the work for riveting. Furthermore, such a furnace must be portable, robust, be simple to operate, and must be marketed at an economic price.

It would be feasible to produce a portable oil-fired or a stationary gas-fired furnace, but electric resistance heating is the more attractive, rather than high or low-frequency induction heating, which is considered uneconomic on objects as small as rivets.

A company of furnace makers, R. M. Catterson-Smith, Ltd., Wembley, developed a prototype, which we illustrate, to the Association's design. It consists essentially of a nearly vertical tube, 36in long, in heat-resisting steel surrounded by a moulded tubular heating element and a refractory lining with a sheet steel outer casing, the whole being mounted on a two-wheel, rubber-tyred chassis. The rivets are dropped into the top of the tube and at the bottom they are ejected one at a time by a manually operated release into a small holding box measuring 5in by 3in by 1$\frac{1}{2}$in. This box is heated with panel elements set into the bottom and the two sides, and has a lid which is normally kept closed and is double-hinged to allow either a partial opening through which a rivet can be removed with minimum loss of heat, or a full opening to cope with any difficulties that may arise should rivets become jammed at the tube exit. Every time a hot rivet is taken out with the tongs, the lever, seen on the side of the unit, is operated to eject a rivet out of the tube into the holding box and a cold rivet is dropped into the top of the tube.

Initial experiments showed that with a power input of 3·5kW in the tube it was possible for rivets to be melted if any delays occurred in their passage through the furnace. It was also found that the degree of heat in the box was insufficient to maintain the temperature of the rivets for any length of time. However, an optimum balance of current input between the tube and the box was finally arrived at whereby it was possible to heat the rivets in the tube to a temperature of around 400 deg. Cent., and even if they were left in the tube there was no danger of them approaching a temperature sufficient to produce "burning" or melting except at the absolute maximum current input. Increase of the current input to the holding box made it possible to heat the rivets further to within the desired temperature range, and also to soak them to achieve a uniform temperature whilst they were being held in the box prior to use. In the final design the total input was approximately 3kW, and the furnace proved capable of delivering three rivets per minute at its maximum rate of working. The total weight of the furnace without control box is 200 lb.

In practice the furnace is brought up to temperature, which takes about forty-five minutes, and then controlled by means of a Sunvic energy regulator. The indicated furnace temperature for the desired rate of output having been established by trial (a pyrometer is fitted in the holding box) the regulator is then manipulated to maintain this temperature. It is important to keep a number of rivets, of the order of a dozen, in the box, since this guards against any shortage of hot rivets and enables the rivets to be further heated, since the temperature in the box is above that in the tube, and a further rise in temperature of the rivets occurs over a period upwards of a quarter of an hour. It is necessary to clear the holding box of rivets if a long delay is anticipated.

The furnace has undergone proving trials in the shipyard of John I. Thornycroft and Co., Ltd., using $\frac{1}{2}$in and $\frac{5}{8}$in diameter rivets in alloy N6. Experience showed that if the empty furnace was switched on full for ten to fifteen minutes and the rivets then placed in it, they reached a temperature of about 400 deg. Cent. in a further thirty minutes, with full current being used. If the control was then reduced to a predetermined value the temperature could be adequately maintained. Thus, with the temperature of the holding box at an indicated value of 580 deg. to 600 deg. Cent. the rivets came out of the furnace about 450 deg. Cent., and by maintaining the indicated temperature at about 600 deg. Cent. the rivets could be obtained from the furnace at a satisfactory temperature for hot driving. The output of heated rivets was two to five per minute for $\frac{1}{2}$in and $\frac{5}{8}$in diameter rivets with shank lengths of 1$\frac{1}{2}$in down to $\frac{3}{4}$in, higher outputs not being demanded. The furnace has been designed mainly to heat $\frac{3}{4}$in and $\frac{7}{8}$in diameter rivets under practical conditions and a slightly narrower feeding tube would be desirable for rivets of $\frac{1}{2}$in and $\frac{5}{8}$in diameter.

During the trial period comparisons were made in the driving times required for hot and cold rivets of $\frac{1}{2}$in and $\frac{5}{8}$in diameter of the same shank length and the following results were obtained :—

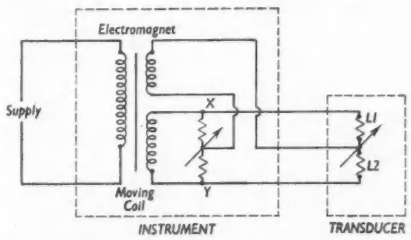
Rivets	Hot driving	Cold driving
1in shank by $\frac{1}{2}$in. dia.	5$\frac{1}{2}$–6 sec	9$\frac{1}{2}$–11 sec
1$\frac{1}{2}$in shank by $\frac{5}{8}$in dia.	10–12 sec	21–23 sec

Further tests with the furnace were carried out in the works of Butters Bros. and Co., Ltd., Glasgow, where rivets of $\frac{3}{4}$in diameter in N6 alloy were being used in the fabrication of a large aluminium alloy crane jib. In general, the output required was not high, since most of the work consisted of driving two to four rivets in one particular connection and then moving to another connection a short distance away, where further rivets had to be driven. In the course of three days' usage in the works satisfactory results were obtained, the hot rivets being readily driven with a 9in stroke hammer.

The prototype furnace was found to have some limitations, mainly of a constructional nature, and minor improvements in the design have suggested themselves as the outcome of the experience obtained in building the prototype and in its operation. The weight could be reduced by using aluminium in the construction of the framework.

A Transducer System for Remote Indication

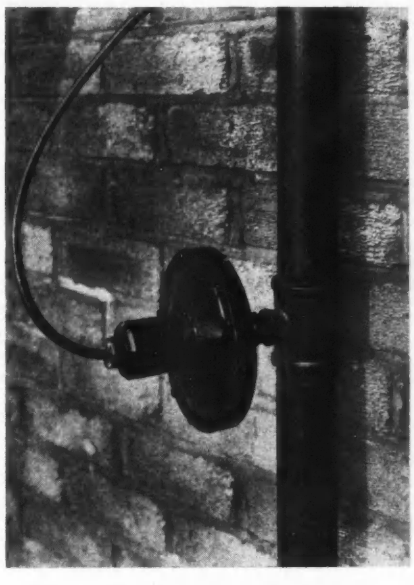
A NEW system for measuring pressures, temperatures or mechanical movements electrically and for indicating the measurement at a distance has been introduced by Salford Electrical Instruments, Ltd., Magnet House, Kingsway, London, W.C.2. The system is a development of the company's original electro-mechanical converter system, but it embodies a smaller



Transducer System for Remote Indication

transducer. It has a variety of applications, including the direct indication of mechanical movements of 0–20, 0–50 and 0–100 thousandths of an inch, by a spring-loaded stylus or, more generally, the measurement of any quantity which can be converted into a mechanical movement.

The principle of the system, as depicted in the accompanying diagram, is that a change in electromagnetic coupling at the transducer (that is, the transmitting end of the system) is balanced by a change in electromagnetic coupling in the indicating instrument at the remote end of the system. The voltage between X and Y depends on the relative values of L_1 and L_2

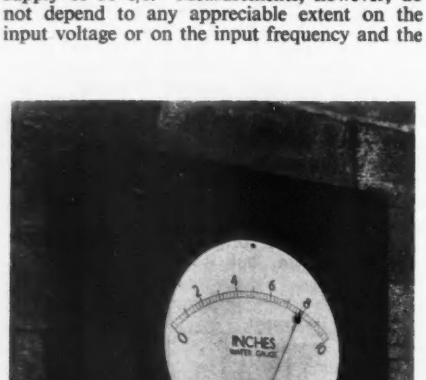


Pressure Transmitter for Remote Indication

which, in turn, depend on the position of the core in the air gap, that is, on the position of the stylus.

The voltage induced in the moving coil from the electromagnet depends on its angle of deflection. The voltage between X and Y is applied to the moving coil and, since this is free to move, it will take up a position such that the electrical torque is zero. Thus, if any change occurs in the position of the core in the transducer, there will be a corresponding change in the position of the moving coil and therefore of the indicator pointer. The magnitude of the voltages and currents in the circuit is of little

consequence, and the system is in fact a form of balanced electromagnetic servo system. The system may be used on either a 230V or a 110V supply of 50 c/s. Measurements, however, do not depend to any appreciable extent on the input voltage or on the input frequency and the



Remote Pressure Indicator

error with changes of voltage of ±15 per cent and of frequency of ±7 per cent does not exceed 1 per cent.

The transducer itself is 2in in diameter by 2½in long. A fixing flange of 2½in diameter can be attached, if required. One of our illustrations shows a pressure-transmitter assembly screwed into a pipeline at a place where the pressure is to be measured. The transmitter embodies a diaphragm assembly consisting of a beryllium copper capsule brazed into a housing and is suitable for low-pressure line measurements down to 10in w.g. in gasworks, waterworks and oil installations.

The indicating instrument, illustrated herewith, is of similar construction to the normal moving coil switchboard instrument with a 100 deg. scale, and it can be installed at any distance from the transducer, provided the resistance of any one conductor does not exceed 25 ohms. To prevent errors caused by stray a.c. pick-up, all three conductors should run within the same cable or conduit. With the normal three-core cable, the maximum distance between the transducer and the instrument is 1000 yards, but provision can be made for greater distances.

The overall accuracy of the system is specified as better than ±1 per cent of full-scale deflection—a value which, it is stated, is maintained within temperatures ranging from 0 to 70 deg. Cent., supply voltage variations of ±15 per cent and frequency variations of ±7 per cent. If required certain kinds of a.c. potentiometric recorder can be used instead of the instrument and the output of up to ten transducers can be switched on to one receiving instrument.

FELLOWSHIP IN METALLURGY.—A research fellowship in metallurgy, tenable in the metallurgy department of Sheffield University, has been established by the United Steel Companies, Ltd. The object of the fellowship is to advance metallurgical knowledge and not to train men for research. The persons to be appointed from time to time, therefore, will be those who have already served their apprenticeship in research and have shown ability to conduct independent investigations. The field of study within which they will be expected to work will be ferrous metallurgy, but this does not exclude the appointment of researchers in refractory matters. The fellowship will be awarded by the Senate of the University. The normal period of tenure will be five years and the fellow will be appointed initially for two years and then annually; remuneration will be a minimum of £750 for the first year, rising by annual increments of £50.

A Sensitive Pressure Switch

By S. K. DEAN, A.M.I.Mech.E.

MEASUREMENT of the rate of flow of granular material presents some problems that can best be solved by a sensitive pressure switch. A simple instrument of this nature has been made at the engineering laboratories at Battersea, London, of the British Iron and Steel Research Association. A description of it may be of interest to others faced with similar problems.

The instrument operates on compressed air and gives an output of pressure from 6in to 30in W.G. For alarm and control purposes a double contact pressure switch was required to operate over this range with a differential of 2½in W.G. A suitable pressure switch was made from a bellows assembly taken from a bombsight Mk. XIV computer and a "3000" type Post Office relay.

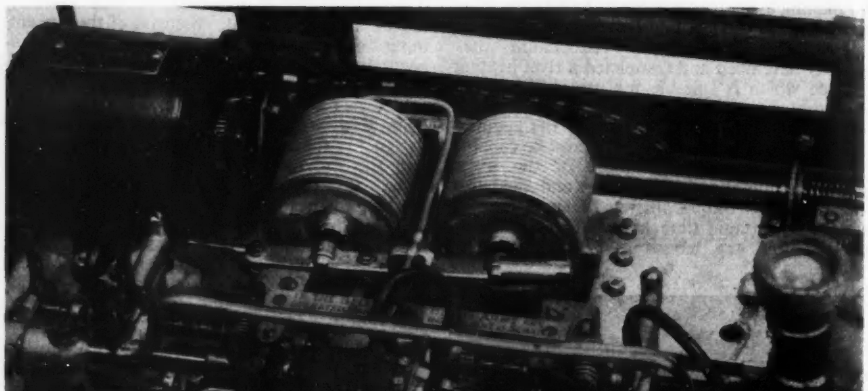


Fig. 1—Bellows Assembly in Bombsight Mk XIV Computer

Fig. 1 is a photograph of a similar bellows system in a bombsight and Fig. 2 shows the completed pressure switch. The bellows assembly was lifted from the bombsight and one bellows removed. The coil was removed from the Post Office relay and the relay frame fixed in the place of the bellows with a piece of 2 B.A. studding. The inner end of the studding projects through to form a stop for the relay armature. A ¼in diameter steel ball placed between the lever and the armature forms a bearing pad. A recess already in the lever retains the ball in place.

Two existing holes in the bellows frame enabled it to be screwed readily to a sheet of 18 gauge steel. A ¼in diameter screw, 2in long, fitted to the plate forms a stop for the lever at the bellows end. The movement of the lever is limited by this stop in one direction and by the brass studding acting against the relay armature in the other direction. The stops were adjusted so that the relay moves through its correct operating distance and the bellows are slightly compressed the whole time. The plate was turned up at one end and a tension spring fitted to the lever and the other cut on the end of a piece of 2 B.A. studding which was passed through the plate and fastened by a nut.

The pressure at which the switch operates depends on the initial tension given to the spring. The pressure differential of the switch depends on the stiffness of the bellows and the spring.

The relay contacts are designed to operate at 50V and 1¼A direct current.

A pressure switch capable of carrying heavier currents and suitable for use in inflammable, dusty or corrosive atmospheres can be constructed from a mercury switch relay such as a Londex "KR/QA."

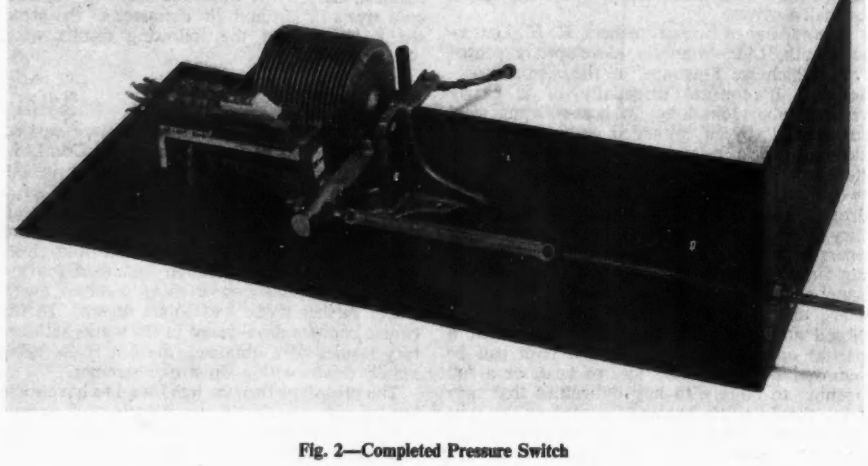


Fig. 2—Completed Pressure Switch

Commonwealth Telecommunications

The chairman's address to the radio section of the Institution of Electrical Engineers was delivered in London on October 14th by Mr. J. A. Smale. He traced the development of the cable and wireless services from the early days of unbridled competition, through the merger in September, 1929, and the second world war, to the conditions leading to nationalisation. Subsequent trends were discussed in the latter part of Mr. Smale's address and abstracts are reproduced below.*

FOLLOWING a Government survey and conference, the first stages of nationalisation became effective in January, 1947, when the assets of the operating company were purchased by the Government. The assets in the self-governing Dominions were taken over and operated by those Governments, and the rest of the system, including the whole of the submarine cable network, continued under the control of the Government-owned operating company. On April 1, 1950, a further stage of nationalisation resulted in the transfer of the assets and operations in the United Kingdom from the operating company to the Post Office.

The outstanding technical advantages of nationalisation in the United Kingdom were the more direct availability of Government research and development in both the radio and cable fields, and the establishment of a policy of cable renewals that would restore the cable network to the highest possible state of efficiency and ensure completely complementary services by cable and by wireless. Technical advantages of the further stage of nationalisation—the transfer of the United Kingdom assets and operations to the Post Office—lie perhaps more in the future : the use of common radio plant for telegraphy and for telephony, which has always been operated separately in the United Kingdom by the Post Office ; the operation of subscriber-to-subscriber telegraphy for which the inland distribution network is important ; and the operation of telephone circuits combined with telegraphy over long submarine cables.

While the United Kingdom, including the operating company, continues to operate the major portion of the Commonwealth network—a portion contributing some 80 per cent of the total revenue—the system as a whole is under the management of a number of separate administrations. Consequently the Imperial Communications Advisory Committee, to which reference has already been made, has been succeeded by the Commonwealth Telecommunications Board with wider terms of reference, still in the advisory field, including the co-ordination of technical provisions and development.

I can only talk briefly about a few of the technical features and the technical policies involved. In the past the final controlling factor has been finance, and it seems likely to continue so in future, although, as a public service, the system is expected to carry Press traffic mainly at uneconomic rates. Until last year our oversea telegraph rates had not been increased over their pre-war level ; in fact, on the average they were slightly lower. Operating costs, mainly the wages bill, had increased, as in every other industry, and it was only the continued high level of traffic that enabled the peacetime grade of service to be restored at pre-war tariffs. When a recession of traffic, coupled with a further rise in operating costs, did set in, the United Kingdom operations were in the process of transfer to the Post Office, and the time was obviously inappropriate for an increase in rates.

The reliability of the cable network, with its freedom from the vagaries of radio, is of enormous value ; but it presents our biggest bill. The country acquired the assets of the operating company at a cost based on maintainable revenue, and the Government case argued an annual expenditure of some 3000 miles of submarine cable on repairs and renewals. The system comprises 150,000 miles of cable, and, while its history has not accurately determined the average life of cable, a great deal of it is known to be reaching the end of its useful life after fifty to seventy years. Eight cable ships are employed on repairs and the smaller renewals, while larger renewals are carried out by the large cable-laying ship " Monarch," which belongs to the Post Office. Modern polythene-insulated cable is used for renewals, thereby either increasing the speed or reducing the size and cost. In the process of laying and repair, cables in deep water are subject to great strain, and the change from guttapercha to polythene presented serious mechanical problems. The most promising development in deep-sea cables since the continuously loaded cables of 1926 is the application of submerged repeaters. The coaxial, repeatered telephone cable is now firmly established for relatively short routes in modest depths ; the technique is being applied to deep-sea and longer routes, and a multi-channel telephone cable across the Atlantic cannot be far away. Even old telegraph cables can be greatly improved by the use of single submerged repeaters near enough to the ends to avoid the necessity for high supply voltages, and far enough from the ends to realise quiet situations and high signal/noise ratios for the amplifiers. The most elegant electro-mechanical relays which have served the cable engineer so well are giving way to electronic devices. Cable ships abound with radio aids, radar and cable buoy reflectors, depth sounding recorders and electronic testing apparatus.

The incidence of cable interruptions is only roughly predictable, but the uncertainties of long-distance wireless circuits render the prediction of performance even more problematical. Mark Twain, observing how scientists differed in their estimations of the length of the Mississippi River, marvelled at " the fascination of a science where one gets such wholesale returns of conjecture out of such a trifling investment of fact." Nevertheless the Commonwealth system relies greatly on the British Propagation Data, and employs valuable predictions for all its circuits. In 1950 the operating company was working some 200 circuits from fifty-two stations scattered throughout the world, and it established a system of post-mortem reports on over 130 predictions sent out each month, thereby contributing in a unique way to a mass of fact which must, in due course, assist in refinement of the fundamental propagation data. This service does not include the prediction of catastrophic interruptions due to ionospheric storms. The latter, like economic prediction as a scientific method, is not merely absurd because impossible, but dangerous because seductive. Such prediction, far from securing us against anything, is likely to expose us to the full fury of the mood of the hour, sometimes over-pessimistic, sometimes over-optimistic.

I referred earlier to the loss of some essential data due to the closing of wireless circuits on the ground of economy. It was even more regrettable that this occurred during periods of sunspot minimum conditions when circuits are more persistently difficult. It is interesting to note the relation of the events I have described to the sunspot cycles. It is of academic interest only that the beginning of wireless (1901) fell in an epoch of rapid recovery from sunspot minimum conditions, because long waves and the accompanying high level of atmospherics do not suffer in the same way as short waves from ionospheric disturbances. The merger of cables and wireless took place at the onset of the 1928–1933 sunspot minimum period, during which the beam wireless circuits had a hard struggle to justify the threat they had so recently presented to the cable system. The next minimum occurred during the war years with the clearance of heavy traffic loads, already handicapped by serious cable interruptions—an unfortunate situation which attracted much criticism of the service. At the time of nationalisation (1947) we were still in the heyday of sunspot maximum ; but the date of transfer of the United Kingdom operations to the Post Office, in April, 1950, could not have been more ill-chosen, for the winter of 1950–51 heralded the worst sunspot minimum conditions that I can remember, a most unfortunate period for a change in organisation and control of this magnitude.

Propagational difficulties led to the pioneer development by the operating company of relay stations. Interruptions to long-distance radio-telegraph circuits are inevitable, and their duration varies considerably, owing to a number of causes. They occur when the most suitable frequency for the circuit is changing so rapidly that it is impracticable to provide additional frequencies for short periods of working. They occur when the route is partly in darkness and partly in daylight and the frequencies required for the different parts of the route are so dissimilar that no compromise is possible—such conditions obviously occur between the United Kingdom and Australia. These interruptions are predictable ; but others are due to ionospheric storms, which are particularly devastating on routes which pass near the earth's magnetic poles. The circuit between the United Kingdom and Canada is probably the worst in this category. When these breaks in communication occur at times of light traffic load no special measures are warranted, but there are occasions when they coincide with peak traffic and are sufficiently long to cause delays. The Commonwealth network normally provides alternative cable or wireless routes on all circuits. Failure of a radio link is covered by a cable link and special radio circuits are opened to cover cable breaks ; but, with the degree of cable interruptions experienced during the war, the alternative and more circuitous cable routes could not handle the volume of traffic thrown on them by the failure of direct radio circuits. Relay stations are situated so that the main route is subdivided into sections on each of which the optimum frequency for the time of day is used, or so that quite different routes are set up to avoid the disturbed regions of the earth. They are situated also, as far as possible consistent with the radio requirement, at main cable stations, because it is often valuable to link cable and wireless routes either automatically or by tape relay.

The performance of relays is dependent upon the telegraph distortion present in the received signals. The successful operation of long cable chains is due to the use of regenerators at each relay point, and the operation of regenerators benefits by the use of a synchronous telegraph system. Electronic regenerators are used in the radio relay stations on synchronous telegraphy, and a mechanical regenerator is used on Morse relays where the speed is varied with conditions.

Telegraph systems, telegraph codes and code converters are being studied in the Commonwealth system in relation to those in general use by foreign countries and on the inland systems in the Commonwealth countries. The general tendency throughout the world is to use the five-unit teleprinter on international circuits, largely in order to standardise equipment and permit of direct interconnection with inland telegraph systems on which this apparatus is firmly established. Until 1941 international radiotelegraph circuits, with few exceptions outside those controlled by the operating company, used Morse, a system requiring skilled operators. For reasons of manpower the war created an urgent need for mechanisation, and the five-unit teletype or teleprinter, being available in quantity and already in use on wire circuits, was the natural choice of the military. After the war the manpower problem was no easier for commercial circuit operators, and the American carrier companies led the world in what proved to be somewhat of a landslide towards the adoption of the five-unit stop-start teleprinter.

The Commonwealth system has not yet participated to any great extent in this method of working, because the operating company had realised mechanisation to a large extent by the use of its system of double-current cable code and direct printer. This system, providing two printing telegraph channels each at seventy-five words per minute, was first applied to the South African beam circuit in 1930. At present some twenty-one circuits into London and twenty-two circuits elsewhere in the network are using it. A change to a different system of mechanisation was therefore much less attractive to the company than was mechanisation itself to other organisations. Further, the company—not alone, perhaps—had experienced serious traffic difficulties with undetectable errors to which the five-unit system, having insufficient redundancy in relation to the signal/noise ratios frequently encountered in practice, was characteristically prone.

The double-current cable code system possesses considerable error-detecting qualities, and, be-

* Cable and Wireless, Ltd.

cause of the redundancy in the cable code, the direct printer indicates both unused combinations and unwanted extra spaces. The adoption of this system arose from the policy of integration of cable and wireless circuits, both as regards through-working by direct interconnection and to facilitate the translation of traffic between one circuit and another by perforated slip. The use of common apparatus simplifies maintenance and the training of maintenance personnel. Consequently, a change to five-unit working on wireless circuits in the Commonwealth network must be viewed in relation to the possibility and expense of adopting the same system on the cables or to the feasibility, having regard to traffic delays, of using code converters. Further, the reluctance to operate wireless circuits with plain five-unit code, with its susceptibility to undetectable errors, particularly in code traffic, must be met by the alternative use of an error-detecting code on teleprinter circuits. The seven-unit code, of which there are several forms, does meet this requirement. It is an equal-length code derived from the five-unit code and has the advantage of permitting a straightforward extension from error detection to automatic error correction.

This does not mean that we have accepted the inevitable existence of errors, and I wish I had time to talk about the various equipments that produce economically an adequate signal/noise ratio both on cable and on wireless circuits; the developments in design or receivers and aerials; the methods of modulating transmitters; and the modern techniques of submarine cable design and operation.

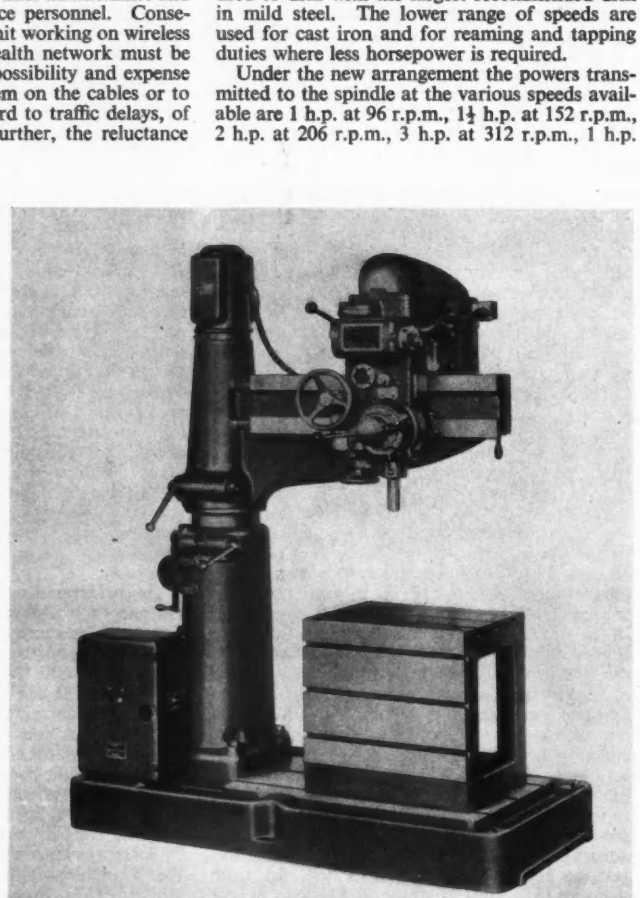
Much has been accomplished in a quarter-century of co-ordinated cable and wireless working to meet the communications needs of the Commonwealth. Already we see the development of techniques to eliminate errors and reduce delays: of modulating methods and frequency control whereby more efficient use is made of the space in the ether available for long-distance radiocommunication; of coaxial cables and submerged repeaters to provide—perhaps in a more stable manner—those new circuit requirements for which space cannot be found in the ether; to provide a subscriber-to-subscriber service for telegraphy as well as telephony throughout the Commonwealth. We can dimly discern in the future the development of fundamental changes in the method of expressing ideas and in the method of coding them for transmission. These things will indeed secure full effectiveness of Commonwealth telecommunications.

A High-Speed Radial Drilling and Tapping Machine

A NUMBER of modifications and improvements have been introduced in the latest design of the "S.V." 3ft, elevating column, radial drilling machine made by Adcock and Shipley, Ltd., Ash Street, Leicester. This machine has a maximum drilling capacity of 1in in mild steel and 1¼in in cast iron.

The standard four-speed, 0·9 h.p. motor previously used, which gave constant power at different speeds, has now been replaced by a rotor stator unit with a long core wound to give different powers at different speeds—that is, it is a constant torque motor instead of a constant horsepower unit. This new driving unit is designed to give 1 h.p. at 450 r.p.m., 1½ h.p. at 710 r.p.m., 2 h.p. at 960 r.p.m., and 3 h.p. at 1455 r.p.m. A back gear is used in conjunction with the four-speed motor, and the top speed with the back gear engaged is the speed which is used to drill with the largest recommended drill in mild steel. The lower range of speeds are used for cast iron and for reaming and tapping duties where less horsepower is required.

Under the new arrangement the powers transmitted to the spindle at the various speeds available are 1 h.p. at 96 r.p.m., 1½ h.p. at 152 r.p.m., 2 h.p. at 206 r.p.m., 3 h.p. at 312 r.p.m., 1 h.p. at 445 r.p.m., 1½ h.p. at 710 r.p.m., 2 h.p. at 955 r.p.m., and 3 h.p. at 1455 r.p.m. Thus the greatest power is available at the speeds used when drilling steel to the maximum capacity of the machine, and when drilling to the maximum capacity in cast iron there is more than twice the power available than there was in the case of the earlier model machines.



Radial Drilling and Tapping Machine

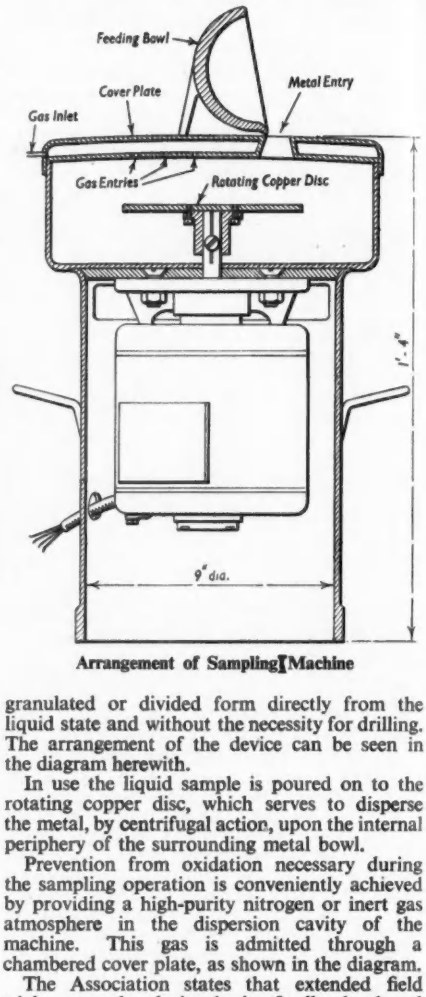
The fitting of a more powerful motor to the machine has necessitated certain changes in the drive to deal with the power developed, and in order to avoid undue increase in weight extensive use has been made of light alloys in the saddle. As can be seen from the illustration of the machine, the saddle controls have been rearranged to give more convenient operation.

Changes have been made in the design of the column and arm to give greater rigidity, and a revised bearing arrangement to allow the arm to swing more freely on the column consists of a ball bearing at the top and a roller chain type of bearing at the bottom. One clamp only is now used to clamp the elevating column on the outer sleeve.

Three rates of automatic feed give 90, 120 and 180 revolutions of the spindle per inch of feed and, in addition to a sensitive hand feed by means of a lever, there is also fitted a slow feed handwheel. The saddle is traversed along the arm by a handwheel and runs on roller bearings. The machine can be fitted with either hand or power-operated means of column elevation, the length of vertical adjustment being 12in. The base has a working area of 24in by 36in and the maximum setting distance between the spindle nose and the base is 47in.

A Rotary Metal Sampling Device

PARTICULARS have been received from the British Steel Castings Research Association of a rotary metal sampling device which is considered to have an important bearing upon productivity in steel-foundries and many iron-foundries. The device is based upon a design developed by the late Mr. S. Westberg, and it enables samples of steel or other metals to be produced in finely granulated or divided form directly from the liquid state and without the necessity for drilling. The arrangement of the device can be seen in the diagram herewith.



Arrangement of Sampling Machine

In use the liquid sample is poured on to the rotating copper disc, which serves to disperse the metal, by centrifugal action, upon the internal periphery of the surrounding metal bowl.

Prevention from oxidation necessary during the sampling operation is conveniently achieved by providing a high-purity nitrogen or inert gas atmosphere in the dispersion cavity of the machine. This gas is admitted through a chambered cover plate, as shown in the diagram.

The Association states that extended field trials upon the device in its finally developed form have demonstrated that it gives the necessary degree of reliability and correlation with analyses performed upon orthodox drilled samples, not only in respect of the normal elements—carbon, sulphur, silicon, phosphorus, and manganese—but also in respect of nickel, chromium, molybdenum and tungsten, over a relatively wide range. These trials were conducted by the British Steel Castings Research Association in conjunction with Westberg Developments, Ltd., of Rotherham, the company now manufacturing and marketing the equipment.

Books of Reference

Welding Manual. Second edition. Bilston: The Quasi-Arc Company, Ltd. Price 7s. 6d. net.—In preparing the new edition of this book opportunity was taken to bring the subject matter up to date and embody the latest practices in metal-arc welding resulting from the company's experience in industry. The manual is arranged in four main sections, the first of which deals with arc welding mild steel—methods, plate preparation, stresses, arc-cutting, &c. Instruction in welding materials other than mild steel is given in the next section of the book, the materials dealt with including high tensile steels, stainless and heat resisting steels, hard surfacing and tool tipping, cast iron, and non-ferrous metals. A third section on welding shop layout and equipment includes chapters on welding sets, clamps, jigs, manipulators, heat treatment and lists of the equipment and electrodes made by the Quasi-Arc Company. The fourth section of the manual deals in particular with the design of welded fabrication.

Industrial and Labour Notes

The National Economy

On Wednesday evening of last week, the Lord Mayor gave his annual banquet to the bankers and merchants of the City of London. The principal speaker was the Chancellor of the Exchequer, Mr. R. A. Butler, who said that the opportunity was one which enabled him to present a progress report on the state of the national economy.

This year's Budget, the Chancellor continued, had started to do its job. It was designed to encourage greater production, and in that the year had seen a significant expansion. In January and February of this year, industrial production was running at about the same level as two years previously, and during March, April and May it rose to about 3 per cent above 1951 and more than 4 per cent above 1952. The provisional figures for July and August were lower because of holidays, of which there had been more this year, but even so, production had been well above last year's level, and much the same as for the corresponding period of 1951. Much that was fundamental, however, still remained to be done.

The first priority, the Chancellor went on to say, was to earn more exports. In the first half of this year, the United Kingdom had a payments surplus on current account of £80,000,000 (including United States aid of £55,000,000), compared with a surplus of £270 million in the whole of 1952. This lower rate, the Chancellor explained, was due mainly to the higher imports in the first half of this year as compared with the second half of last year, when this country was feeling the full weight of the import cuts and was also producing less. In the third quarter, this country and its partners in the sterling area had not done badly, with a rise in the gold and dollar reserves of 119 million dollars during a period when there was always an adverse seasonal trend. That, however, the Chancellor emphasised, was not enough, for it must be remembered that more than 25 per cent of the national income was earned overseas. Exports had been keeping up, but the country must do much better if it was to fight its way to a position of safety. The second major problem, the Chancellor said, was coal. The level of coal production must cause concern to everybody, and all must therefore work together—Government, management and men—in friendly co-operation to raise output per manshift. Of the 5,000,000 tons of coal lost through extra holidays, 3,000,000 tons had now been regained, but that still left a deficit of 2,000,000 tons. All who used coal had their part to play in making the most efficient use of so essential a source of wealth. The Government could and would help by creating the right conditions to encourage productive effort on the one hand, and the prevention of waste on the other.

Report on the Electrical Contracting Dispute

The report of the Court of Inquiry into the dispute between the National Federated Electrical Association and the Electrical Trades Union was published at the end of last week. The court was set up, by the Minister of Labour, on September 11th, under the chairmanship of Mr. John Cameron, Q.C., after a series of strikes in the electrical contracting industry in various parts of the country. The strikes, which were approved by the Electrical Trades Union, were concerned with a claim for a wage increase. The National Joint Industrial Council for the industry failed to reach agreement on the matter.

The report sets out very fully the history of the dispute and the progress of wage negotiations between the two parties. It records also the submissions made to the court by both sides. It then goes on to say that, from the evidence, it is clear that neither side has operated the industry's existing joint machinery for negotiation to its full effect, and that "each side has been imbued with a suspicion of the methods and motives of the other." The court feels that "now the misunderstandings and misapprehensions have been cleared away," there is no reason why an honest attempt should not be made to review the claim in the light of the whole circumstances as they exist to-day. If in such negotiations, the report says, no agreement can be found either upon a basis for the calculation of wages or for a determination of the wage rate itself, then one or both of these matters should be referred to arbitration by the voluntary action of the parties. If the parties think that they have a good case, nothing can be lost by discussion, or if need be, by arbitration ; it is only a bad case that will not stand impartial investigation.

The European Steel Industry

The steel committee of the United Nations Economic Commission for Europe has recently held a meeting which was attended by representatives of twelve European countries, and of Canada and the U.S.A. Among the matters discussed was the advantage of international co-operation in market research and in improving the commercial and technical services rendered both in the home and export markets. The committee considered a study entitled "European Steel Exports and Steel Demand in Non-European Countries," which has been prepared by the secretariat, and note was taken of a survey of the European steel market in 1953, which is now being made. This survey, it was stated, would give special consideration to the falling trend in steel demand and the general change from seller's to buyer's market conditions. Another matter discussed by the committee was the question of rising competition between steel and aluminium. It was stated that a "steel-aluminium" study had already been drafted by the secretariat, and it was decided that if it was deemed desirable, a working party consisting of experts from the steel and aluminium industries and from the principal consuming industries should consider the study in detail.

Industrial Employment in Wales

The report of Government action in Wales and Monmouthshire for the year ended June 30th last (Cmd. 8959), which has been published by H.M. Stationery Office, says that Welsh industry has maintained the high level of employment reached in the earlier post-war years of expansion. It adds, however, that as in 1951–52, this favourable position was not held without reverses in some sectors. The total number of persons unemployed was higher, month by month throughout the period, than at corresponding times in 1951–52. It rose from 23,529 in July, 1952, to 33,501 in February of this year, and then declined to 25,682 by June.

Dealing with industrial employment generally, the report says that, in the twelve months reviewed, the basic industries of coal, iron and steel maintained their position, and in the manufacturing industries employment increased slightly. In the aluminium industry, employment declined in Wales as in other parts of the United Kingdom, and there was some short-time working as well as redundancy of labour. In the tinplate industry, practically the whole of which is in Wales, there was a more substantial fall ; the industry began to discharge large numbers of workers as mills closed down in the early months of this year, and short-time working became widespread in the late spring, when a four-day week was generally adopted. The main improvements in the manufacturing industries were increases in male employment in engineering, aircraft and vehicles, electrical goods, leather goods and textiles, the latter industry registering the largest increase. The level of overtime working remained fairly constant during the year. On the average, 670 firms and 33,920 operatives working a total of 277,000 hours' overtime in each week surveyed, circumstances which, the report states, were fairly representative of the whole field of manufacturing industry in Wales.

Elsewhere in the report it is mentioned that in the post-war period 453 factory projects have been completed, and that a further 182 are under construction or approved and licensed for building or are approved as to location. These figures include 188 Government-financed factory projects, already completed in the development areas, and six others under construction.

Education and Training

Speaking at the annual conference of the British Association for Commercial and Industrial Education on Friday last, the Minister of Labour, Sir Walter Monckton, Q.C., emphasised the importance of training and education in relation to national economic recovery. Sir Walter referred to the vast field of technical education and training, and said that he wanted to give any encouragement which might be in his power to the various courses of work study of which a great deal more would be heard. He felt sure that the wider application of the principles of work study, with simplification of design and manufacturing processes, was going to be a big factor in reducing costs and raising productivity in some of our industries.

Sir Walter went on to express appreciation of the work being done by local joint apprenticeship committees. He said, however, that he could not help feeling some disappointment at the lack of response to his Ministry's request that some of the larger industries should look at their apprenticeship schemes and see what adjustments could be made to enable older school-leavers to obtain apprenticeships. Some young people who stayed on at school beyond the statutory school-leaving age wished to become apprentices and were well fitted to do so, and industry should be careful to see that undue rigidity in apprenticeship arrangements did not preclude such young people from obtaining apprenticeships.

Finally, Sir Walter stressed the importance of making proper use in industry of those who had been trained. He said that the calibre of some of the students from universities and technical colleges was very high. If there was need for the technical colleges and universities to increase their facilities for technological training, industry must be able to absorb the people they produced at levels and in circumstances which would offer the promise of worthwhile careers.

Industrial Investment

According to *Bulletin for Industry*, which is a review of the economic situation prepared by the Treasury, there has been a steady volume, over the last five years, of industrial investment which in 1951–52, in spite of some fall in 1952 was 20 per cent larger in real terms than in 1948–49. It is stated that the share going to manufacturing has been distributed so as to favour the more important classes of investment, enabling industry to increase output and exports in a way most beneficial to the economy. The *Bulletin* says that manpower is now generally adequate for a further increase in output, although shortages of skilled men in engineering persist. But, it is claimed, future output levels will depend increasingly on the further expansion and modernisation of those sectors of industry whose market prospects are most promising.

The *Bulletin* shows that, at 1948 prices, the annual rate of gross fixed investment in plant and machinery averaged just over £500 million a year in 1948 and 1949 and just over £600 million a year in 1951 and 1952. In real terms there was an increase of 20 per cent from 1948–49 to 1951–52, despite a slight fall in 1952. In 1952, the plant and machinery intake in manufacturing industry was still about a third greater than in 1948, and total investment was up by a quarter and, it is added, there is some evidence to suggest that this year the 1952 levels will be at least maintained.

Another point brought out in this survey is the marked change that has occurred in the pattern of output and exports, compared with pre-war, the expansion in British industry being broadly in line with the shifts in world demand. Thus, the engineering products industries now account for 40 per cent of manufacturing output compared with under 30 per cent in 1935, and for nearly 40 per cent of the United Kingdom's exports, compared with about 25 per cent in 1938.

Notes and Memoranda

Air and Water

OIL POLLUTION OF THE SEA.—The Minister of Transport and Civil Aviation, Mr. Alan Lennox-Boyd, has consented to open an unofficial conference in London on October 27th, when the problem of oil pollution of the sea will be discussed. Private citizens from ten nations are attending the conference, which has been called by an independent committee.

LOW-PRESSURE OIL BURNERS.—We have received from White's Marine Engineering Company, Ltd., a copy of a pamphlet with the title "Unitrol Low-Pressure Air Atomising Oil Burners." The burner has been designed for furnaces, crucibles and small steam boilers, and the pamphlet gives a general description of the fitting together with drawings showing sectional elevations.

S.S. "GOTHIC." — The Shaw Savill steamship "Gothic," which is to carry the Royal Party for part of the Commonwealth tour, returned to Liverpool on October 21st to load cargo, after undergoing trials in the Clyde. Further trials will be carried out after sailing from Liverpool on October 26th and the ship, which is due to arrive in London on October 29th, will sail on November 10th for Kingston, Jamaica, where the Queen will embark.

N.E.C. INSTITUTION.—The first general meeting of the North-East Coast Institution of Engineers and Shipbuilders for the current session was held on October 16th and inaugurated the Institution's seventieth year. The 1952–53 report of the Council, which was presented at the meeting, besides referring to the papers read during the session, touched upon the activities of the Tees-side branch and of the Student Section. Among the awards noted was that of the M. C. James Medal for the paper "The Preservation of Oil Tanker Hulls," by Mr. John Lamb, and Mr. E. V. Mathias, while the Institution's scholarship for 1953 was awarded to Mr. W. J. Hennessey. The report records the gift received from Lord Weir and also the sum provided by Mr. Gilbert J. Innes for making a triennial award for papers on the strength of ships' structures and materials. Reference is made to the Newbiggin measured mile towers and to tests made by the B.S.R.A. of the prototype apparatus for measuring ships' speeds by radar.

Miscellanea

ROYAL SHOW, 1954.—The Royal Agricultural Society has announced that at next year's Royal Show, which is to be held in Windsor Great Park, there is to be a display of ancient and historical vehicles.

TUNGSTEN ORES.—The Ministry of Materials announces that from October 20th, its selling price for tungsten ores of standard 65 per cent grade and ordinary quality has been reduced as follows: wolframite from £15 10s. to £14, and scheelite from £15 to £13 10s. per long ton delivered consumers' works.

MR. C. A. MALONE.—We have learned with regret of the death of Mr. C. A. Malone, which occurred suddenly at his home at Bamford, Derbyshire, on October 13th. Mr. Malone was managing director of Burys and Co., Ltd., Sheffield, and a local director of Samuel Osborn and Co., Ltd., which firm he joined in 1919. He was also on the board of Cooke and Stevenson, Ltd.

WILLINGTON POWER STATION.—The British Electricity Authority has received the consent of the Minister of Fuel and Power to the building of a new power station (Willington) in the Repton district of Derbyshire. It will have an installed capacity of 400MW, made up of four 100MW turbo-generators, each served by a single boiler having an evaporative capacity of 830,000 lb of steam an hour.

TRACTOR ECONOMY.—The tractor division of David Brown Corporation (Sales), Ltd., has prepared a leaflet which is intended to assist tractor users in assessing the respective merits of diesel and vaporising oil engines. The leaflet sets out the capital and average running costs of diesel and vaporising oil-engined tractors, and includes also some notes on servicing costs and on the pulling power of both kinds of tractor.

FURANE RESIN.—We are informed that Leicester, Lovell and Co., Ltd., North Baddesley, Southampton, is now making a range of furane resins which are sold under the name "Cascote." These resins in addition to being resistant to weak and strong acids, alkalis and solvents, are claimed to have a hard and durable surface which makes them resistant to erosion and abrasion. Their resistance to high temperatures is stated also to be very good.

COMMERCIAL AND INDUSTRIAL FORECASTING.—A course of eighteen lectures on "Commercial and Industrial Forecasting" is being arranged by the Regent Street Polytechnic for directors and senior executives. The lectures will be delivered at St. Katharine's House, 194, Albany Street, London, N.W.1, on Thursday afternoons, from 3.30 p.m. to 5.30 p.m., beginning on November 12th. The course is to be conducted by Mr. Eric Shankleman.

COAL ECONOMY AT COLLIERIES.—At a meeting of the Institution of Mining Engineers in London on Saturday, October 17th, Messrs. W. Rowell, G. S. Jenkins and J. W. Pirie read their paper, "Coal Economy at Collieries: Summary and Conclusions of the Symposium Papers." This paper summarised the eight papers which the federated institutes, at the invitation of the Council of the Institution of Mining Engineers arranged for presentation and discussion at meetings during the Session 1952–53. In dealing with the main points regarding economies at collieries, the authors divided the paper into two main parts. The first part referred to the economies that could be achieved in preparing the run-of-mine coal for the market, and the second part such economies as could be achieved in the internal consumption of fuel. Since the eight papers covered such a wide field the authors could not condense the subject without omitting certain aspects. They attempted, however, to make the paper practical by including only those items over which it was thought control, and subsequently economy, could be most readily achieved.

A DEMONSTRATION OF MACHINE TOOLS.—We are informed by the Rockwell Machine Tool Company, Ltd., Welsh Harp, London, N.W.2, that it is staging an exhibition of unusual machine tools in its London showrooms from November 3rd to 11th inclusive, and in the Birmingham showroom from November 16th to 24th inclusive. Among the twenty-five machines demonstrated under power there will be Thiel tool room milling machines, filing machines for diamond filing of hard steels and tungsten-carbide, together with many other tool room and production machines which created considerable interest at the recent Brussels Fair and have not hitherto been shown in this country.

SYMPOSIUM ON CATHODIC PROTECTION.—The corrosion group of the Society of Chemical Industry is arranging a symposium on "Cathodic Protection," to be held at the Institution of Electrical Engineers, Savoy Place, London, W.C.2, on Friday, November 13th. The morning session will begin at 9.45 a.m. and the following papers will be presented:—"Cathodic Protection in Relation to Engineering Design," by K. A. Spencer; "The Effect of the Composition of Magnesium Anodes on Their Efficiency," by M. Oudeman; "Development of Cathodic Protection in Belgium," by A. Weiler; and "Economic Aspects of Corrosion Control," by D. H. Lewis and O. C. Mudd. At the afternoon session, beginning at 2.30 p.m., the papers to be discussed are:—"Cathodic Protection and Corrosion Control in the Middle East," by W. C. R. Whalley; "Cathodic Protection: Its Application to Canadian Marine Vessels on Active Service," by K. N. Barnard; and "Application of Cathodic Protection to Ships and Establishments of the Royal Navy," by J. T. Crennell. A fee of £1 will be payable by non-members of the Society of Chemical Industry attending the symposium.

THE IRON AND STEEL INSTITUTE.—The autumn general meeting of the Iron and Steel Institute is to be held at 4, Grosvenor Gardens, London, S.W.1, on Tuesday and Wednesday, November 24th and 25th. The proceedings begin at 2.15 p.m. on November 24th, when, after the formal business, the following papers are to be discussed: "The Effect of Emissivity and Flame Length on Heat Transfer in the Open-Hearth Furnace," by Mr. M. W. Thring; "Experiments on Flame Radiation in an Empty Open-Hearth Furnace," by Mr. W. P. Cashmore and Mr. M. W. Thring; "The Length of Oil and Gas Flames," by Mr. A. L. Cude, and "Water Cooling of Open-Hearth Furnaces," by Mr. A. M. Frankau. At a morning session on November 25th, beginning at 9.45 a.m., the papers to be presented for discussion are: "The Notched Slow-Bend Test as a Brittle Fracture Test," by Mr. J. E. de Graaf and Mr. J. H. van der Veen; "The Fracture of Alpha Iron," by Mr. C. F. Tipper and Mr. E. O. Hall; "Intergranular Brittleness in Iron-Oxygen Alloys," by Mr. W. P. Rees and Mr. B. E. Hopkins; "The Cleavage Strength of Polycrystals," by Mr. N. J. Petch, and "Tensile and Impact Properties of High-Purity Iron-Carbon and Iron-Carbon-Manganese Alloys of Low-Carbon Content," by Mr. N. P. Allen, Mr. W. P. Rees, Mr. B. E. Hopkins and Mr. H. R. Tipler. The meeting will conclude at 1.15 p.m., and at 2.15 p.m. on Wednesday, November 25th, a symposium on "Sinter" will begin. It will continue throughout Thursday, November 26th, with sessions at 9.45 a.m. and 2.15 p.m.

Contracts

BROOKE MARINE, Ltd., is to build a single-screw steel river and coastal tug having a length overall of 48ft 8in by 12ft 4in beam by 5ft moulded depth and powered by a Thornycroft RZ/6 diesel engine of 85 b.h.p.

THE BOSTON DEEP SEA FISHING AND ICE COMPANY, Ltd., has placed an order with the Goole Shipbuilding and Repairing Company, Ltd., for a trawler 128ft in length by 26ft 6in beam by 13ft moulded depth, having propulsion machinery consisting of a Mirrlees Bickerton and Day diesel engine developing 750 b.h.p. at 250 r.p.m.

THE NORTH OF SCOTLAND HYDRO-ELECTRIC BOARD has placed the first of the main contracts for its Breadalbane hydro-electric scheme. The scheme was briefly described in THE ENGINEER of April 6, 1951. James Miller and Partners, Edinburgh, have been awarded the contract to build the Lubreoch dam in Glen Lyon and to construct permanent access roads in Glen Lochay and Glen Lyon. A start has already been made on the roads, and bridges in both glens are being strengthened. Edmund Nuttall, Sons and Co. (London), Ltd., is to build the Stronuich dam in Glen Lyon and the 5-mile-long main tunnel from the dam to the generating station in Glen Lochay. The value of each contract is over £2,000,000. On the St. Fillans section of the scheme, Struthers and Denny, Edinburgh, are carrying out improvements to the Comrie–Glen Lednock road to provide access to the dam, which will be built in that glen. Work on two small hydro-electric schemes in Argyll has also started recently. They are the Kilmelfort scheme, near Oban, which will produce about 9,000,000 units annually, and the Allt-na-Lairige scheme, which will yield about 17,000,000 units of electricity per annum. The civil engineering contractors for the Kilmelfort scheme are R. J. MacLeod, Ltd., Glasgow, for the River Oude works, and Wm. Arnott McLeod and Co., Ltd., Edinburgh, for the Loch Tralaig dam and other works. The civil engineering contractor for the Allt-na-Lairige scheme is Marples Ridgway and Co., Ltd., London.

THE GENERAL ELECTRIC COMPANY, Ltd., has received from the Steel Company of Wales, Ltd., a contract, valued at £300,000, for the complete electrical equipment for two 42in temper mills, which are to be installed at the new Velindre Works at Morriston, near Swansea. The new temper mills are being built by Davy and United Engineering Company, Ltd., Sheffield, and each will be equipped with two 1000 h.p. motors for the main stand drives, two 500 h.p. and two 250 h.p. tension roll motors and two 300 h.p. motors for the uncoiler and reel.

Personal and Business

SHELL-MEX AND B.P., Ltd., announces the appointment of Mr. L. H. Coney as lubricants co-ordinator.

MR. PAUL W. REDWAY, sales manager of Skinningrove Iron Company, Ltd., has been appointed a director.

ADMIRAL SIR CECIL H. J. HARCOURT, G.B.E., has been appointed a director of Dewrance and Co., Ltd.

MR. W. L. BROWN has been appointed chief engineer of Transformers (Watford), Ltd., Sandown Road, Watford, Herts.

MR. R. B. POTTER, chairman of Simon-Carves, Ltd., has joined the board of Davy and United Engineering Company, Ltd., Sheffield.

MR. MERVYN W. SHORTER, general sales manager of Westinghouse Brake and Signal Company, Ltd., has been appointed managing director.

MR. O. R. GUARD, formerly chairman of the Southern Gas Board, has been appointed deputy chairman of Associated British Engineering, Ltd.

MR. V. ALFORD has been appointed chief information officer to the Ministry of Transport and Civil Aviation, at Berkeley Square House, London, W.1 (telephone, Mayfair 9494).

MR. M. HARTLAND THOMAS, F.R.I.B.A., has relinquished the position of chief industrial officer of the Council of Industrial Design to resume private practice as an architect and industrial designer.

DR. A. ROSEN, M.I.E.E., has been appointed telecommunications consultant in the engineering organisation of British Insulated Callender's Cables, Ltd., in succession to the late Dr. Hans Carsten.

NEWTON VICTOR, Ltd., announces the removal of its head office and London branch office to 132, Long Acre, London, W.C.2 (telephone, Covent Garden 0861; telegrams, "Stabilizer, Rand, London").

CHAMBERLAIN INDUSTRIES, Ltd., Staffa Road, Leyton, E.10, states that its mechanical engineering division has appointed Lavite, Ltd., Cawley's Mill, Cleckheaton, as stockist and distributor of its products in Yorkshire.

TURNER MANUFACTURING COMPANY, Ltd., Villiers Street, Wolverhampton, announces the appointment of Mr. J. D. Greenway as its overseas envoy. Mr. R. L. Beverley has been appointed home sales manager, diesel sales.

WESTOOL, Ltd., St. Helen's Auckland, Bishop Auckland, Co. Durham, is now manufacturing electro-magnetic brakes and clutches under licence from the Warner Electric Brake and Clutch Company, Beloit, Wisconsin.

WICKMAN, Ltd., Coventry, states that it has become the sole agent in the United Kingdom for Maskinfirma R. L. Carlstedt, Malarhojden, Stockholm, Sweden, and Maschinenfabrik Weingarten A.G., Weingarten/Wurttemberg, Germany.

THE BRITISH BROADCASTING CORPORATION announces the following appointments:—Mr. H. Walker, assistant superintendent engineer, television studios; Mr. W. D. Richardson, assistant superintendent engineer, television outside broadcasts.

VACU-BLAST, Ltd., announces the formation of a subsidiary company known as Vacu-Blast Contractors, Ltd., to undertake shot blasting on a contract basis. The new company's address is 291, Aberdeen Avenue, Slough, Bucks (telephone, Slough 24507).

MR. W. E. HARDEMAN, manager of the tyre design division of Dunlop, Ltd., has been appointed chief tyre development engineer. Mr. L. J. Lambourn has been appointed manager, and Mr. E. S. Tompkins, deputy manager of the tyre design division; Mr. L. J. Mountford has become manager of the tyre performance division, and Mr. H. R. Fletcher, manager of the aircraft tyre division.

THE CLAN LINE STEAMERS, Ltd., and THE HUNTING GROUP OF COMPANIES announce that the two concerns have joined together to form a new holding company known as Hunting-Clan Air Holdings, Ltd., and that Hunting Air Transport, Ltd., will operate in future under the name Hunting-Clan Air Transport, Ltd. Mr. P. L. Hunting is to be chairman and other members of the board will be Lord Rotherwick, Sir Nicholas Cayzer, Bt., Mr. C. P. M. Hunting, Mr. L. C. Hunting, Hon. Anthony Cayzer, Mr. R. R. S. Cook and Mr. J. A. Thompson.

British Patent Specifications

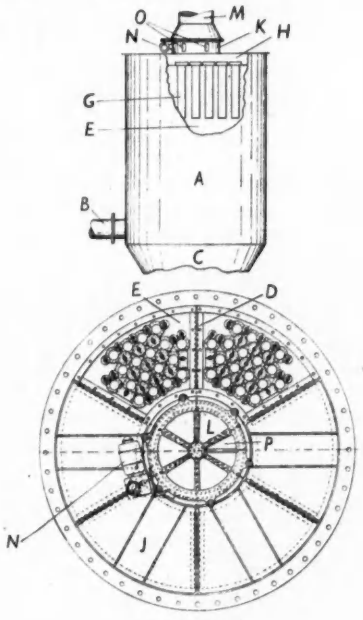
When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application : the second date, at the end of the abridgment, is the date of publication of the complete specification.

Copies of specifications may be obtained at the Patent Office Sales Branch, 15, Southampton Buildings, Chancery Lane, W.C.2 2s. 8d. each.

FILTERS AND SIEVES

697,345. January 15, 1951.—AIR AND GAS FILTERS, Henry Simon (Holdings), Ltd., Bird Hall Lane, Cheadle Heath, Stockport (*Inventor : Peter Norman Veale*).

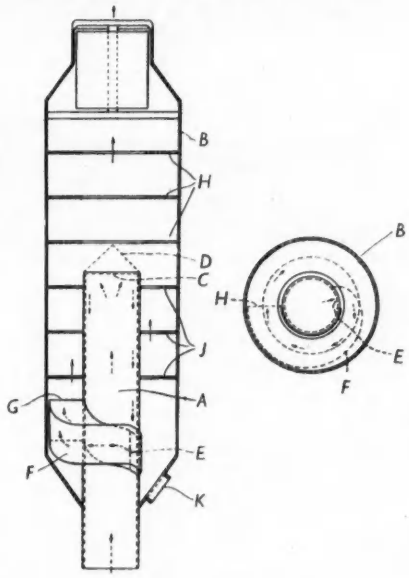
The object of the invention is to provide a filter in which the filtering elements are automatically cleared of any adherent material. As shown in the drawings, the filter comprises a casing *A* into which the dust-laden air is admitted by the branch pipe *B*, the dust falling to the hopper base *C*. The casing is divided by vertical partitions *D* in sections *E*. In the construction illustrated are six sections *E*, each closed by a top cover plate dividing the casing into upper and lower parts from which are suspended groups of tubular filter elements *G* closed at their bottom ends and opening at their top ends into compartments *H*. Each compartment has a removable cover *J*. The partitions do not extend to the bottom of the casing, so that there is a common supply of dust-laden air through the duct *B* to the several sections. Centrally upon the top of the filter casing is a cylindrical valve casing or stator *K*, which has ports *L* in its base corresponding in number to the sections of the filter casing. The top of the stator communicates by a duct or conduit *M* with an exhaustion system. There are relatively narrow apertures in the wall of the stator, each aperture coming above a port *L*. Within the stator *K* is a valve rotor which is revolved by a motor *N* through a chain wheel. Whilst the valve rotor is slowly revolving suction is applied to the insides of the filter elements *G* of five of the six compartments *H* and five of the sections *E* of the filter. Dust is therefore separated by the filters *G* from the air passing through them. Some dust may cling to the filters and other dust may fall from the filters to the bottom *C* of the filter casing. The remaining compartment *H* is, however, isolated from the clean air outlet *M* by the section *P* of the rotor until it is opened to the atmosphere for a short time by its port *O* coming into line with an aperture in the stator, when the section *P* is brought to atmospheric pressure. The suction action in the casing tends, therefore, to produce a reversed flow through the filter elements in the section of the filter which is not in communication with the exhaust duct. Any solid material which clings to the filtering elements is thereby freed from them and drops into the bottom of the casing.—*September* 23, 1953.



No. 697,345

697,623. October 3, 1950.—CATCHING AND QUENCHING SPARKS OR GLOWING PARTICLES, Aktiebolaget Tydens Patenter, Norr Mälarstrand 64, Stockholm, Sweden.

The invention relates to a spark catcher which holds back large particles of glowing coal in stream of combustion gases. In the drawing a duct *A* for the combustion gases projects into a cylinder *B*. The end of the duct is closed by a wall *C* or a conical cover *D*. The duct has an opening *E* at some distance below the wall *C* through which the combustion gases enter a conduit *F*, extending helically along the duct wall which, through an outlet *G* directs the gases in a cyclone path through the drum. When the glowing particles impinge against the wall *C*, the largest of them are crushed by impact, and this process is supplemented by rings *H* and *J*, which are attached to the drum wall. In the helical passage of the gases through the drum the particles are forced into the corners between the drum wall and the rings, where they are further reduced in size. The apparatus may be provided with an opening *K* through which the largest particles, which are not carried along by the gas stream, but fall downwards, can be removed.—*September* 23, 1953.



No. 697,623

METALLURGY

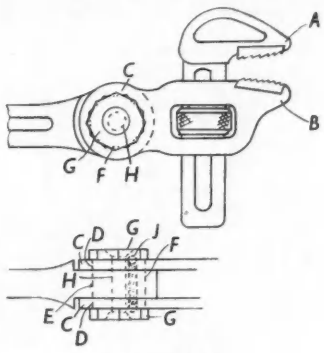
697,294. September 5, 1950.—THE COLOURING OF COPPER AND ITS ALLOYS, Imperial Chemical Industries, Ltd., Imperial Chemical House, Millbank, London, S.W.1. (*Inventor : Joseph Bernard Cotton.*)

The invention relates to the colouring of copper and copper rich alloys and in particular to the formation of an antique green colouration or patina. It has been found that the double salt copper ammonium chloride ($CuCl_2.2NH_4Cl.2H_2O$), produces a pure green patina but in order to produce a surface which more closely resembles the natural patina produced on copper due to long-term atmospheric weathering, the double salt is applied with an amount of ammonium sulphate in the form of a solution, the effect being to produce a patina having blue-green colour. A typical solution might contain : copper ammonium chloride 20 grammes ; ammonium sulphate 10 grammes ; water 100 grammes. It has further been found that uniformity of the artificial patina is best attained when the solution is allowed to form in droplets over the surface of the metal. A suitable solution for spraying may have the following composition : copper ammonium chloride 20 grammes ; ammonium sulphate 10 grammes ; "Antifoam A" 0·02 grammes; water 100 grammes. To produce a satisfactorily adherent patina, the relative humidity should be between 85 per cent and 100 per cent, although humidities as low as 65 per cent may be used, providing that the period of weathering is accordingly lengthened. If the humidity is less than 65 per cent the patina is likely to peel after subsequent soaking.—*September* 16, 1953.

TOOLS AND WORKSHOP APPLIANCES

697,368. October 14, 1950.—WRENCHES AND SPANNERS, F. L. Wraight and Co., Ltd., Vulcan Works, Mucklow Hill, Halesowen, Birmingham, and Charles Thomson, of the company's address.

According to the drawing the pipe wrench has the outer jaw *A* adjustably mounted in the inner jaw *B*. The back of the inner jaw has two ears *C* projecting from it which have octagonal holes *D*. The inner end of the handle has an octagonal hole *E* and is placed between the ear pieces to receive a pin *F* which passes through the holes to fix the handle rotatably to the ear pieces. The pin is removable to enable the angular position of the handle to be changed. In order to fix the octagonal pin in position, end plates *G* of the same size as the pin across the flats are mounted by a centre fixing pin *H* so that after it has been threaded through the aligned holes in the handle and ear pieces, the plates can be turned out of register with the holes in the ear pieces and thus prevent endwise movement of the pin. A spring-loaded ball *J* is mounted in the pin and engages recesses in the plates to hold them in the locking position and registering with the holes.—*September* 23, 1953.

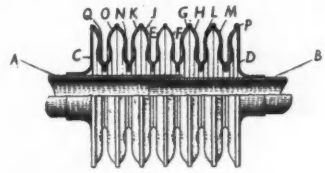


No. 697,368

TUBE AND PIPE COUPLINGS

697,138. July 6, 1951.—METALLIC BELLOWS PIPE EXPANSION JOINTS, Titeflex, Inc., 500, Frelinghuyen Avenue, Newark, 5, New Jersey, U.S.A.

The invention relates to bellows used for connecting movable parts to provide a fluid-tight expansion joint between them. It provides a bellows to withstand high-frequency vibrations and avoid failure at or near the attaching flanges. Referring to the drawing there are shown two exhaust pipes *A* and *B*. A flange *C* is welded to the pipe *A* and a flange *D* to the pipe *B*. Between the flanges a number of diaphragms are arranged so that the flanges are connected by a fluid-tight casing which will permit them to move longitudinally with flexing of the diaphragms. The central diaphragm element comprises two diaphragms *E* and *F* of uniform thickness. In a bellows having a central aperture of 2¼in in diameter and an outside diameter of 3¼in, sheet metal of 0·005in in thickness may be used. It will be seen also that the diaphragm elements on each side of the central element, comprised of diaphragm elements *G* and *H*, and *J* and *K* are of uniform thickness, but greater than that of the diaphragms *E* and *F* ; sheet metal 0·0075in thick may be used. The next diaphragm elements flanking the central group of three are shown of laminated construction, each of these, namely, *L* and *M*, and *N* and *O*, being formed of two layers of sheet metal 0·005in thick. Finally, the last diaphragms *P* and *Q* at each end of the bellows are also of laminated construction consisting of one layer of 0·005in thick sheet metal with another of 0·0075in for a total thickness of 0·0125in. The number of diaphragm elements may be extended to provide a longer bellows by using still thicker sheet metal or by laminating as indicated or by both. Two other designs are shown in the specification.—*September* 16, 1953.



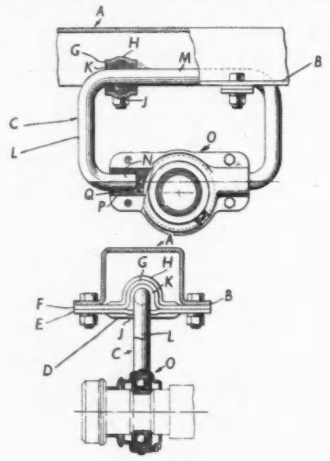
No. 697,138

BEARINGS AND SUPPORTS

697,263. June 22, 1951.—RESILIENTLY MOUNTED SHAFT HANGER ASSEMBLY, Thompson Products, Inc., 2196, Clarkwood Road, Cleveland, Ohio, U.S.A. (Assignees of Edward J. Herbenar.)

In the drawings, *A* is a frame or other supporting member forming a part of the chassis or undercarriage of a vehicle. The frame *A* has its open side facing downwards and a pair of laterally extending flanges *B* run along the open side of the channel. The assembly *C* is supported from the channel frame by sub-assemblies *D*, each comprising a generally flat strap *E* and a looped strap *F* extending across the open side of the channel frame and secured to the flanges by means of bolts. The looped strap is provided with a closed loop portion *G* that extends into the interior of the channel frame, which is provided with a curved portion *H*. The flat strap is provided with a similar portion *J*. Within the closed loop portion is a preloaded rubber bushing *K*. A hanger *L* is suspended from the channel frame by

means of the strap sub-assemblies, with the long side of the C-shaped hanger, indicated at *M*, mounted in the rubber bushings. The short end portions *N* of the hanger *L* are arranged in opposed, spaced and aligned relationship, between which is mounted a bearing housing *O*. The bearing housing comprises a



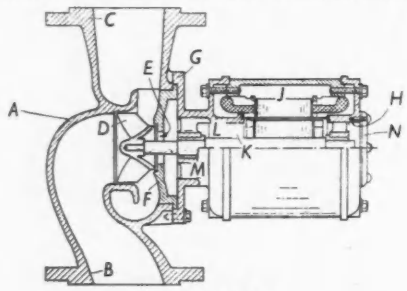
No. 697,263

pair of mating, stamped metal shells as shown, which provide a pair of aligned end sockets *P*. Pre-loaded rubber bushings *Q* are set in the end sockets for mounting the hanger ends. The bushings are thimble shaped, with their inner ends closed and their outer ends receiving the end portions *N* of the hanger. The housing *O* includes a ball bearing race, in which is journalled the stepped driven shaft.—*September* 16, 1953.

PUMPS

697,634. February 13, 1951.—CIRCULATING PUMPS FOR CENTRAL HEATING PLANTS, Karl Rutschi, of Pumpenbau Brugg K. Rutschi, 3, Freudensteinstrasse, Brugg, Switzerland.

The invention relates to a circulating pump for central heating plants, which is driven by a "sleeved-gap" motor, the operation and direction of motion of which can be seen from outside the motor.



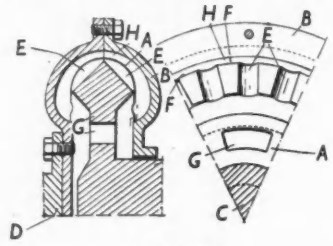
No. 697,634

In the drawing a pipe adapter *A* is formed as a pump casing and comprises an inlet *B* and a delivery *C*. In the adapter is a semi-axial impeller *D*, the shaft of which projects through a lateral opening *E* of the junction *F* into the adapter *A*. The sleeved-gap motor is provided with a connecting flange *G*, and an end flange *H*. The stator winding *J* is sealed from an inner space in which the rotor of the motor is disposed, by means of a separating sleeve *K* representing the gap-sleeve, and made of non-magnetic material. The shaft of the pump impeller is directly coupled to the rotor. The space *L* communicates with the inside space of the pipe adapter *A* through openings *M* in the flange and the central aperture of the connection piece *F*. As shown, a round inspection opening is recessed at the end flange *H*, which opening is covered by a window *N*. The possibility is thus given of readily ascertaining from the outside the operation and the direction of rotation of the water-filled motor or of its shaft.—*September* 23, 1953.

POWER TRANSMISSION

697,557. July 4, 1951.—CENTRIFUGAL POWDER COUPLINGS, Ferdinand Badin, 27, Rue de Constantinople, Paris, 8.

The coupling shown in the drawings comprises a rotor *A* of toroidal shape in a casing *B* of similar shape. The rotor is keyed to a shaft *C* whilst the casing is secured to another shaft *D*. Around the rotor a number of grooves *E* are provided which are of generally circular cross-section, their profile being less than a semi-circle. These grooves or recesses are inclined and extend radially. They are associated in pairs to form a kind of vee on either side of this rotor. Between two groups of two consecutive grooves at the periphery of the rotor protrusions *F* are thus formed, which constitute one of the walls defining the restricted gaps of spaces between the rotor and the casing. The curvature of the casing is such that the gap between the rotor and the casing gradually decreases along radial planes up to the plane of symmetry common to the rotor and the casing. Openings *G* are provided through the flange of the rotor for the purpose of balancing the amounts of powder in each half of the casing. Whatever be the direction of rotation, the powder rotated by the



No. 697,557

driving member tends to collect at the periphery of the casing. The grooves *E* enhance this radial motion of the powder, and the walls of these grooves form inclines tending to urge the powder towards the gaps between the protrusions *F* and the wall of the casing. Heaps of packed powder such as *H* are thus formed on these protrusions. The chocking up of these heaps of powder thus formed between the two parts of the coupling is furthered by the gradual narrowing, in the radial direction, of the gap between the rotor and the casing. The powder having been directed along the inclines formed by the walls of the grooves, towards the restricted gaps, the amount of powder remaining inside these grooves is relatively small. When the heaps of powder are strongly chocked up, the two parts of the coupling are secured to one another and power is transmitted. When motion is stopped, the heaps of powder completely collapse and the two parts of the coupling are loosened from one another. Modified constructions are also shown in the specification.—*September* 23, 1953.

British Standards Institution

All British Standard Specifications can be obtained from the Sales Department of the Institution at 2, Park Street, London, W.1.

COPPER PLATES FOR GENERAL PURPOSES

No. 2027 : 1953. Price 2s. 6d. This standard applies to rolled copper plate in the annealed condition in thicknesses over ¼in and over 12in in width. It specifies quality of material, tolerances and mechanical properties and includes details of mechanical testing.

BLACK BOLTS, SCREWS AND NUTS, HEXAGON AND SQUARE, WITH B.S.W. THREADS AND PARTLY MACHINED BOLTS, SCREWS AND NUTS, HEXAGON AND SQUARE WITH B.S.W. OR B.S.F. THREADS

No. 916 : 1953. Price 3s. The main purpose of the revision of this standard is to take account of current practice in the manufacture and use of black bolts and nuts. It is recognised that during the transition period which must elapse before the adoption of unified threads becomes general, B.S. 916 will continue in use, and it is obviously desirable that the general requirements for the bolts and nuts covered by this standard should be consistent with those in B.S. 1769, "Unified Black Hexagon Bolts, Screws and Nuts—Heavy Series." The new standard accordingly provides both for the black product with B.S.W. threads and for bolts, screws and nuts with partly machined finishes; bolts faced under the head, with or without turning on the shank, may also have B.S.F. threads.

In addition to specifying dimensions and tolerances for bolts, screws and nuts from ¼in to 6in inclusive, the standard includes requirements for material, squareness of thread to face of nuts, recommendations for drilled holes and split-pin sizes, dimensions of plain washers for bolts up to 2in nominal size, and stock lengths of hexagon head black bolts in sizes up to 1in.

FISHMEAL AND OIL PLANT.—"Fish Meal and Oil Plant" is the title of a booklet, which we have received from Rose, Downs and Thompson, Ltd., in which the equipment manufactured by the company is briefly described. There is a diagrammatic flow sheet for fish meal and oil production and an outline of typical installation accompanied by process data. Unit construction dryers and cookers are touched upon together with such processes as liquor treatment and solvent oil extraction, while brief reference is made to the plant for whale factories.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

ASLIB

Tues., Oct. 27th.—Royal Society of Arts, 8, John Adam Street, London, W.C.2, "Information Available to Exporters: The Source and Nature of Information and Statistics of Home and Overseas Markets."

BRITISH INSTITUTION OF RADIO ENGINEERS

Thurs., Oct. 29th.—N.W. BRANCH: College of Technology, Manchester, "The Electron Microscope: Development, Construction, Limitations and Applications," A. W. Agar, 7 p.m.

CHEMICAL SOCIETY

To-day, Oct. 23rd.—BIRMINGHAM: The University, "Analytical Errors: Heinous and Otherwise," T. B. Smith, 4.30 p.m.——ABERDEEN: Robert Gordon's Technical College, Aberdeen, "Structure Stereochemistry and Inclusion Compounds of Some Phenol Derivatives," W. Baker, 7.30 p.m.——GLASGOW: The Royal Technical College, "Fluorescence of Solutions," E. J. Bowen, 3.30 p.m.

INCORPORATED PLANT ENGINEERS

Mon., Oct. 26th.—W. AND E. YORKS BRANCH: The University, Leeds, "Interplanetary Flight," J. Humphries, 7.30 p.m.
Thurs., Oct. 29th.—SHEFFIELD AND DISTRICT BRANCH: Grand Hotel, Sheffield, "Concrete: Mass, Reinforced, Prestressed," D. L. Lee, 7.30 p.m.
Fri., Oct. 30th.—BIRMINGHAM BRANCH: Imperial Hotel, Birmingham, "Calculating Machines: Past and Present," G. A. Montgomerie, 7.30 p.m.

INSTITUTE OF BRITISH FOUNDRYMEN

Wed., Oct. 28th.—LONDON BRANCH: Waldorf Hotel, Aldwych, W.C.2, "Shell Moulding," A. Emmerson, 7.30 p.m.

INSTITUTE OF ROAD TRANSPORT ENGINEERS

Tues., Oct. 27th.—N.E. OF ENGLAND GROUP: Royal County Hotel, Durham City, "Electrical Equipment as Applied to Heavy Commercial Vehicles," W. A. Bevis, 7 p.m.

INSTITUTE OF WELDING

Sat., Oct. 24th.—SOUTH LONDON BRANCH: Visit to G. A. Harvey and Co., Ltd., Greenwich.

INSTITUTION OF CIVIL ENGINEERS

Tues., Oct. 27th.—MARITIME SECTION: Great George Street, Westminster, London, S.W.1, "Overhaul and Repair of Lock Gates in the Port of London," J. T. Williams, 5.30 p.m.
Fri., Oct. 30th.—YORKSHIRE ASSOCIATION: Royal Victoria Station Hotel, Sheffield, "Traffic Engineering in the U.S.A.," J. A. Hillier, 7 p.m.——MIDLANDS ASSOCIATION, GRADUATES' AND STUDENTS' MEETING: Room 129, Civic Centre, Birmingham, "Design and Erection of T.V. Masts," 6.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS

Mon., Oct. 26th.—RADIO SECTION: Savoy Place, London, W.C.2, Discussion on "Long-Playing Disc Records Compared with Magnetic Tape for Sound Reproduction in the Home," opened by H. F. Smith, 5.30 p.m.
Tues., Oct. 27th.—N. MIDLAND CENTRE: British Electricity Authority, 1, Whitehall Road, Leeds, 1, "Uses of Earthed Signal Conductors on Transmission Circuits," W. Casson, 6.30 p.m.
Wed., Oct. 28th.—SUPPLY SECTION: Savoy Place, London, W.C.2, Chairman's Address, L. G. Brazier, 5.30 p.m.——TEESSIDE SUB-CENTRE STUDENTS' MEETING: Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough, Chairman's Address, R. A. Hore, 6.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS

To-day, Oct. 23rd.—SOUTHERN BRANCH: The Brighton Technical College, "Trends in Industrial Power Engineering with Reference to Fuel Conservation," J. Fox, 7.30 p.m.
Fri., Oct. 30th.—GENERAL MEETING: Storey's Gate, St. James's Park, London, S.W.1, "Some Practical Aspects of Cutting Tool Nomenclature Arising from Recent Research," D. F. Galloway, 5.30 p.m.

INSTITUTION OF STRUCTURAL ENGINEERS

Wed., Oct. 28th.—WALES AND MONMOUTHSHIRE BRANCH: South Wales Institute of Engineers, Park Place, Cardiff, "Research Work in Soil Mechanics at the University College of Swansea," A. A. Fordham, 6.30 p.m.
Thurs., Oct. 29th.—LANCASHIRE AND CHESHIRE BRANCH: Reynolds Hall, College of Technology, Manchester, Chairman's Address, J. A. L. Matheson, Films, 6.30 p.m.
Fri., Oct. 30th.—MIDLAND COUNTIES BRANCH: Room 129, Civic Centre, Birmingham, "The Design and Erection of B.B.C. Television Masts," 6.30 p.m.

IRON AND STEEL INSTITUTE

Wed., Oct. 28th.—IRON AND STEEL ENGINEERS' GROUP: 4, Grosvenor Gardens, London, S.W.1, Twenty-Third Meeting, 10.30 a.m. to 12.45 p.m., and 2.0 p.m. to 4.0 p.m.

JUNIOR INSTITUTION OF ENGINEERS

To-day, Oct. 23rd.—Townsend House, Greycoat Place, London, S.W.1, "Waste Heat Recovery as Applied to Diesel Engines," R. M. Tufnell, 7 p.m.
Mon., Oct. 26th.—N.W. SECTION: Engineers' Club, Albert Square, Manchester, "The Construction of a 30 Cubic Centimetre, Six-Cylinder Petrol Engine," F. W. Waterton, 7 p.m.
Fri., Oct. 30th.—Townsend House, Greycoat Place, London, S.W.1, Film Evening, 7 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS

Fri., Oct. 30th.—The Engineers' Club, Albert Square, Manchester, "Water Turbines and Their Applications," G. M. Hardman, 6.45 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS

Fri., Oct. 30th.—Literary and Philosophical Society's Lecture Theatre, Newcastle upon Tyne, "Internal Stresses in Some Types of Forgings," C. Sykes, 6.15 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY

Tues., Oct. 27th.—Manson House, Portland Place, London, W.1, "Static and Dynamic Performance of Sheathed Industrial Thermometers," A. R. Aikman, J. McMillan and A. W. Morrison, 7 p.m.